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PALÆONTOLOGY.

ON THE ORIGIN AND DEVELOPMENT OF THE EXISTING HORSES.

BY JACOB L. WORTMAN.

Within the past few years the fossil deposits of the West have become so noted for their production of fossil remains, that American palæontology must be assigned its appropriate rank, as a leading feature of American science. It is a lamentable fact that our educational institutions, generally good in other respects, are, with few exceptions, little prepared to teach the important results that have been reached in this field of investigation, but content themselves with a presentation of the subject as it appeared fifty years ago. The most reasonable explanation of this lack of interest on their part is probably found in the circumstance that they are ruled by a feeling adverse to the general conclusions favorable to the doctrine of evolution inevitably reached in a study of this branch. This results in the selection of unqualified men to fill the appropriate chairs, and who do not apprehend the true significance of the evidence produced.

The absolute inter-dependence of important questions in biology, as well as the necessity of such knowledge in the general "make-up" of a scientific education, are strong arguments in favor of a more extended study of palæontology.

A complete knowledge of the origin and development of any single form is seldom made out, and I may safely say that it was not until the authors of the Evolution Hypothesis brought forth their arguments to show that existing species

have been developed from pre-existing forms by physical means, that any real progress was made in the solution of this problem. As many of these changes must have occurred in the remote past, it is necessary to know the history of their geologic succession. Palæontology, therefore, affords us the primary basis upon which both advocates and opponents of this theory must rest their opinions and formulate their beliefs. Evidence bearing directly upon the past succession of several groups of the *Mammalia* has of late years been accumulating to such an extent as to render it now possible to construct their phylogeny and discern with a comparative degree of certainty the exact lines through which they have descended to their present condition.

For this purpose I have selected as the subject of this article a member of an order known to naturalists as the *Perissodactyla*, a name derived from two Greek words meaning odd-toed. In defining the systematic position of this animal it will be necessary to discuss the classification of, first, the order to which it belongs, and second, the various sub-divisions included within the order itself. In the pursuit of this course the use of technicalities is unavoidable, but these I will endeavor to make as clear as the circumstances will permit.

As considerable has already been written upon the genealogy of the horse by others, it might appear imprudent for me to say more. But unfortunately the nomenclature that has been used renders it quite impracticable for the palæontologist to ascertain to what forms reference is made. The genera *Eohippus*, *Orohippus*, *Miohippus* and *Pliohippus*, have not, in the author's estimation, been distinguished from genera previously described and figured by other authors; hence my reasons for adopting names more in accordance with the prevailing nomenclature of the science.

The *Perissodactyla* may be defined as mammalian animals having both pairs of limbs fully developed and adapted for walking or running. Toes with terminal phalanges encased in strong corneous sheaths developed as hoofs. But as these characters apply to two other orders also, viz: the "cloven-hoofed" or *Artiodactyla*, and the "short-footed" or *Amblypoda*, it will be necessary to consider the characters that establish the differences between these natural groups. It must be observed that the anatomical features that separate these orders are to be found mainly in the structure of their hind limbs. A comparison with the *Artiodactyla* shows that the hind feet always possess an odd number of toes, while in that order the number is permanently even, as far at least as our present knowledge extends. The third digit of each foot is symmetrical in itself, which is not the case in the *Artiodactyla*. An important bone of the "hock" joint which corresponds to the ankle-bone of man, and to which the name astragalus has been given, presents either a single articular face to the navicular bone below or has, more commonly, a small facet in addition for articulation with the cuboid bone. The femur, or thigh-bone, possesses a strong third trochanter for the insertion of the *gluteus maximus* muscle, a process not found in the corresponding bone of the "split-hoofed" division. The astragalus in the *Artiodactyla* has its inferior surface divided into two subsequal facets, which are very convex antero-posteriorly

and separated by a distinct trochlea or pulley-like depression from before backward, and forming a perfect hinge joint in its articulation with the cuboid and navicular bones respectively. The superior surface of this bone in both these orders is strongly convex fore and aft, and is traversed by a deep groove passing outward and backward which receives a corresponding elevation on the distal face of the tibia.

Another ungulate or hoof-bearing order to which they hold near relationship, has been separated and defined by Prof. E. D. Cope in his Report on Captain Wheeler's Survey West 100th Mer., under the name *Amblypoda*, a term meaning short-footed. They are as yet confined to the Eocene period exclusively, and are found both in Europe and this country. In points of affinity to the hoofed orders generally they occupy a most interesting and important position; being in all probability the oldest, and offering the most generalized condition known among the ungulates. The brain capacity is exceedingly small in relation to the size of the other parts of the skeleton, and from certain casts made from the brain case itself we are warranted in assigning these animals a position among the lowest mammalia; they are lower in brain development even than some of the *Marsupials*. The feet are very short, are provided with five fully developed toes, and have their entire plantar and palmar surfaces applied to the ground, as in the modern bears. The astragalus is greatly flattened from above downward, and is primitive and characteristic. It displays upon its inferior surface flattened articular facets for both navicular and cuboid bones which share the articulation about equally. Upon the superior portion, the surface articulating with the tibia, it is almost flat, a condition which must have rendered the ankle joint capable of very little movement and giving to these animals a peculiarly awkward and shambling gait. It is not difficult to perceive that these small brained five-toed and plantigrade *Amblypoda* could easily have furnished a starting point for both the *Artio* and *Perissodactyla*, and, as we have good reasons to believe, did give origin to the *Proboscidea* or elephants. Figs. 1, 2 and 3 illustrate the difference noticeable in the feet of hind limbs of the three orders. Fig. 1 represents foot of an *Amblypod;* Fig. 2, that of a *Perissodactyle*, and Fig. 3 that of an *Artiodactyle*.

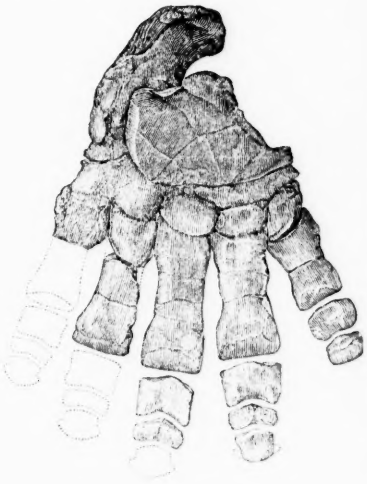


FIG. 1.

Right posterior foot of a species of *Coryphodon*, after Cope; one-half natural size.

From the study of collections recently made by the writer in the lower Eocene beds of Wyoming, Prof. Cope divides the *Perissodactyla* into two sub-orders.

These he calls *Condylarthra* and *Diplarthra*. Their distinctive characters are found in the inferior extremity of the astragalus,—and its manner of articulation with the cuboid and navicular bones. In the former the distal face of the astragalus is convex in every direction, and articulates with the navicular alone, while in the latter this portion of the bone is considerably flattened and unites with both navicular and cuboid, although the surface for the latter is quite small and insignificant in comparison with the former. The *Condylarthra* includes as yet

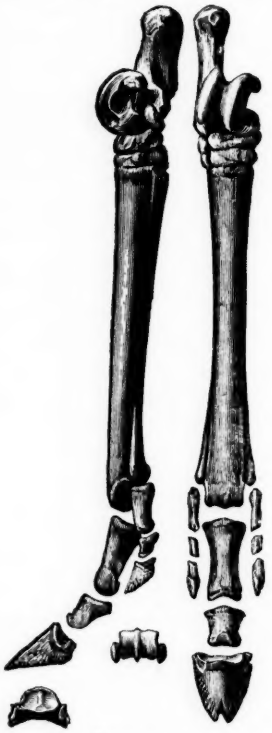


FIG. 2.

Right posterior foot of *Protohippus sejunctus* Cope, from Colorado, about one-half natural size. From Report U. S. Geol. Sur. Terrs. F. V. Hayden, IV.

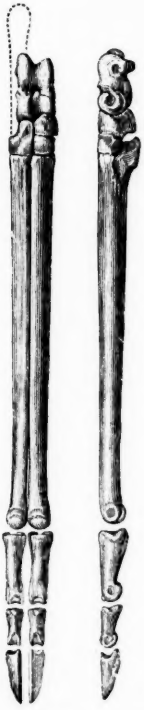


FIG. 3.

Right posterior foot of *Poebrotherium labiatum* Cope from Colorado, three-fifths natural size. From Hayden's Report, IV, Pl. CXV.

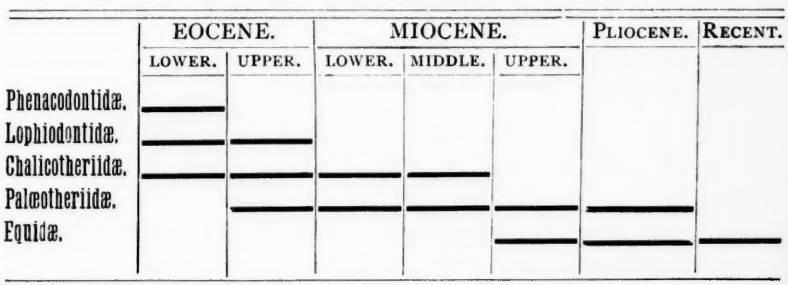
two families, *Phenacodontidæ* and *Menisco theriidæ*, whose remains have been found so far only in the lower Eocene deposits of this country. It is interesting to note that they are the most generalized of any known *Perissodactyla*, and supply us with a link long and earnestly sought for in the evolution of the latter and more specialized forms of this order. The feet are considerably shortened and furnished with five toes in functional use upon each, a character which at once constitutes an approach to the *Amblypoda*. The molar teeth are

of the simple four-lobed pattern, resembling in this respect the suilline *Artiodactyla*.

The *Diplarthra* on the other hand are more numerous, and embrace a much larger number of forms. They are divisible into ten families, including forty-eight genera, variously distributed throughout geologic time. As but four of these families concern us for the present, I will spare the memory of the reader by not discussing the classification of the others.

The first of all to which attention may be directed is the *Lophiodontidæ*, embracing eight well defined genera which are not positively known to have existed later than the upper Eocene epoch. They may be recognized, first, by the possession of four toes upon the anterior and three toes upon the posterior limbs; second, by the molar and premolar teeth being different (Fig. 7), and third, by the non-separation of the anterior and posterior external cusps of the superior molars by an external rib-like pillar. The next family is the *Chalicotheriidæ*, to which ten genera are referred. The digital formula is the same as in the *Lophiodontidæ*, as is also the relation of the molar and premolar teeth. The only distinction is found in the separation of the anterior and posterior external lobes by a vertical ridge. The remains of this family range from the lower Eocene to the middle Miocene, inclusive. The third family is the *Palæotheriidæ*, having three toes upon each foot. The molars and premolars are alike and the inferior molars possess perfect double crescents.

The fourth and last family is the existing *Equidæ*, in which the digital formula is reduced to one toe upon each foot. The molars and premolars are alike and highly complex in structure. It is to this family all the existing horses belong, and it has been traced as far back as the upper Miocene strata. The relations in time of these families may be exhibited as follows:



Having determined then the position that the horses hold in relation to other allied forms, as well as their geologic station, we are now prepared to trace the history of their past succession, and point out the successive steps in modification of structure by which one of the most specialized conditions known among the ungulates has been reached. But before proceeding it may be well to understand just here what is implied by this term specialized and what constitutes specialization in these forms. For the purpose of explanation I introduce a short digression.

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Among existing animals in which the teeth possess short crowns with low blunt tubercles on their triturating face, (the bunodont type of dentition) we observe correspondingly simple digestive apparatus assiciated with a short intestinal canal. In other animals, as many of the existing ungulates for example, the crowns of the teeth are greatly lengthened in a vertical direction, uniformly broadened, and the face presents a complex folding of the enamel plates, (the selenodont type of tooth). Here we notice more complicated digestive organs associated with great length of alimentary tube. The relation of these conditions to the character of the food upon which the respective types subsist is obvious. The Bunodonts require condensed and nutritious diet for their support, and are omnivorous, while the Selenodonts are fitted to subsist upon food containing a smaller proportion of the nutritive elements but of which greater quantity is required. The former are as a general rule dwellers in swamps and forests and live upon nuts, berries, and roots, while the latter occupy the open plains and subsist upon the grasses and branches of trees. Now, any influence sufficiently potent to compel the bunodont ungulates to forsake their natural habitat and live in the open field would also entail corresponding modification or extinction. Such we can easily conceive would be the effects of climatic change or greater incursions from carnivorous enemies. Once in the open field, speed would become a desideratum as a condition of safety, hence the foot with a reduced number of digits would possess many advantages over the polydactyle one. Specialization therefore, I conceive to consist in greater and more perfect adaptation to the conditions under which the animal survives.

With these facts in view then we may proceed. Prof. Cope ventured the assertion some years ago* that the quadritubercular or four-lobed bunodont tooth was the archetypal pattern in which all the more specialized selenodont molars had their origin. This proposition may now be regarded as demonstrated, and the passage from this type of tooth to the highly complicated form in the animals under consideration, I will attempt to show, has been close and consecutive, and intimately associated with reduction in digits.

As the *Phenacodontidæ*, Cope, plainly present us with this hypothetical condition both as regards the teeth and the number of digits upon each limb, they cannot be regarded otherwise than as the primitive ancestors of the succeeding members of this important and once populous order. There has been probably no discovery among the ungulates since the finding of the *Amblypoda* that has proved equal in interest and importance to the discovery of this group. The descent of all the ungulates from the *Amblypoda* has been held by Prof. Cope for some time, but that this derivation took place from any known genera of this order, the comparatively specialized condition of the teeth of the latter distinctly forbids. This moderate complexity of the teeth among Eocene mammals is a striking exception especially when associated with such a low grade of organization of other parts as we find in these animals. The explanation of this fact must

* "On the Origin and Homologies of the Types of Molar Teeth of Mamalia Educabilia." Jour. Acad. Sci., Philadelphia, 1874.

in my judgment be sought for, in their large size, and possession of powerful canine teeth which would grant them greater immunity from the attacks of their fierce carnivorous contemporaries. With these means of defense they could take up their abode in pastures where food more congenial to their tastes was furnished; hence we can with perfect consistency look for a rapid modification of these organs accompanied with slight change in others. In order to make the connections complete between them and the Phenacodonts there should yet be found an Amblypod with bunodont molars reduced canines, and a more elongated foot. An approach to this condition as far at least as the molar teeth are concerned is found in a new genus recently described by Prof. Cope under the name *Manteodon* (prophecy tooth). The Phenacodonts present considerable variety of structure as far their anatomy is at present known. Prof. Cope has described five genera. One genus, *Catathlæus*, shows a peculiar sculpturing of the outside of the molar teeth similar to that seen in many reptiles, and is the only mammal known to possess it. In the genus *Anacodon* the molar teeth lack distinct tubercles, a character which assigns it the lowest position in the family. Phenacodus on the other hand approaches nearest to the Lophiodonts in dental characters, and is here taken for illustration. The teeth are forty-four in number, and are disposed as follows: Incisors $\frac{3}{3}=\frac{3}{3}$, Canines $\frac{1}{1}=\frac{1}{1}$, Premolars $\frac{4}{4}=\frac{4}{4}$, Molars $\frac{3}{3}=\frac{3}{3}$. Fig. 4 represents a superior molar of a species of this genus; *ae* is the anterior external, *pe* the posterior external, *ai* the anterior internal and *pi* the posterior internal lobes respectively. They are low, obtuse and constitute the principal cusps of the crown. *acc* and *pcc* are the anterior and posterior cross crests which are rudimentary and represented by isolated tubercles in this animal, but which are developed into important structures in the more specialized genera. *y* is the rudimental external rib separating the antero and postero-external cusps.

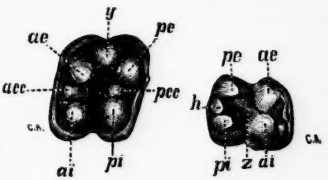

FIG. 4. FIG. 5.

Fig. 4.—Left sup. molar of a species of *Phenacodus*. Natural size; *y* is drawn too large. (After Cope).

Fig. 5.—Left inf. molar of same. Natural size. (After Cope.

An antero-basal lobe arising as an outgrowth from the cingulum or ledge surrounding the base of the crown is strongly marked in some genera. In the inferior molars (Fig. 5) the four principal cusps hold the same relation to the crown and are lettered as above. *z* represents a low, indistinctly marked ridge, passing from the postero external to the antero internal cusps *pe ai*. The antero internal cusp *ai* is sometimes double. *h* is the heel which is so strong in the last molar as to be called a fifth lobe. It is connected by a faint ridge with the postero external cusp *pe*.

The feet as already stated possess five toes upon each foot. Fig. 6 exhibits a diagram of a left anterior foot in which the third digit *M iii* is the largest. The second and fourth *M ii* and *M iv* are about equal to each other in size but smaller, while the first and fifth are unequal and still more reduced.

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From this group we pass to the lower forms of the *Lophiodontidæ* which appear as contemporaries of the *Phenacodontidæ*. This fact in itself points to a greater antiquity of the Eocene fauna than the Wasatch or lower Eocene epoch.

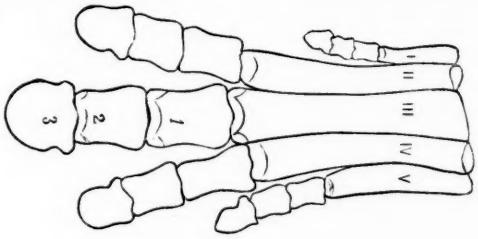

FIG. 6.

Diagram of left posterior foot of *Phenacodus pinnævus*. About one-half natural size.

The sudden appearance of a fauna comparatively high in the scale of organization without announcement in the preceding formation, as is the case with the present, materially affects the belief in gradual transitions. But when we stop to consider that the earliest known appearance of the Mammalia, is in the Triassic rocks, and that in two intervening formations, Cretaceous and Laramie, not a single bone of a Mammal has yet been found, we may confidently look to future discovery for a complete removal of this seeming inconsistency.

[*To be Continued*]

EUROPE BEFORE THE ARRIVAL OF MAN.

BY JOHN FISKE.

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The most interesting feature of Eocene Europe was the peculiar character of its mammalian fauna. At first we find marsupials, and carnivora with marsupial affinities, showing that the order of carnivora was then only beginning to be evolved. Afterward came such creatures as the *anchitherium*, the ancestor of the horse, in general aspect somewhere between the Shetland pony and a pig, and with three separate hoofs on each foot. There were also the *anoplotheria*, or common ancestral forms of antelopes and deer, as yet without horns or antlers. The highest order of mammals, the Primates,—including man, ape, and lemur, —was then represented by the *adapis* of the Paris basin, the *necrolemur* of southern France, and the *cænopithecus* of Switzerland. Now none of these Eocene primates answered to any living genus of lemur, though the lemurs are the least specialized of primates now existing ; but all these Eocene primates showed signs of relationship, in one way or another, to the hoofed quadrupeds living at that time, which, as we must not forget, were only on the way toward becoming hoofed quadrupeds such as we know. Cousinship, however remote, between

such extremely specialized creatures as the horse and his rider seems odd to think of; yet the lemuroids of the Eocene furnish the link. And it is interesting to remember that, owing to the closeness of relationship, the lemuroid *adapis* was actually mistaken by Cuvier for an *anoplotherium*, or primitive antelope-deer. Of all anatomical contrasts, what can be greater than the contrast between a solid hoof and the flexible five-fingered hand of a Rubinstein? Yet the Eocene great-uncle of our modern pianists could be mistaken for his contemporary great-uncle or great-grandfather of our hoofed quadrupeds! And this instance is but one fair sample out of many of the changes which the last five or six or eight million years have wrought.

Speaking generally, it may be said that in the Eocene age there were carnivora, and there were ungulata, and there were primates; but these orders were not so clearly distinguished from each other as they are to-day, and they are not so clearly distinguished from other orders, such as the rodents and insectivora, while in many cases they had not ceased to bear the marks of their marsupial ancestry. Or, to put the case in another way, in the Eocene period you have an instance of hoofed quadrupeds, but you don't find an instance of any such special form as horse or deer or camel; you find carnivora, but you don't find a clear instance of *felis* or *canis* or *ursus*,—not even of hyæna, an earlier type than either of the others; and you find primates, but among these there is nothing yet so clearly distinguished as a monkey. In short, the present *species* or *genera* of mammals had not come into existence in the Eocene period, but only the present *orders* and some of the present *families*; and even the orders were not clearly distinct from one another, as they are at present; but they were closely interlocked, very much as species are at present. In other words, the whole class of mammals in the Eocene age was far less highly specialized than it is at the present time.

From these premises Mr. Boyd Dawkins argues, with convincing force, that man could not possibly have existed in Europe, and probably nowhere on the earth, during the Eocene period.

At a time when the order of ungulates had not clearly developed the distinction between camels and pigs and horses, and when the order of primates was only just beginning to be distinguished from other orders, so that Cuvier could even mistake a primate for an ungulate,—at such a time was it at all likely that man, the most highly specialized of all primates, or of all animals, could have existed? Obviously, he could not have existed at such a time. The supposition is absurd on the face of it. As Mr. Boyd Dawkins says, "to seek for highly specialized man in a fauna where no living genus of placental mammal was present would be an idle and hopeless quest."

Coming to the Miocene age, we find traces of extensive submergencies of parts of the European continent, followed by re-elevations. Considerable portions of Gaul and Italy were laid under water, and at one time the whole basin of the Danube was covered by a sea which connected with the Mediterranean near Berne, thus reducing Switzerland and Italy to an archipelago. The Alps,

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however, seem to have maintained a relative height as great as that of to-day, in comparison with the lands about them. The elevated position which Britain had occupied in the Eocene age seems to have been kept up during the Miocene. The whole of Britain a d Ireland, with the English and Irish channels, the German Ocean, and the Atlantic ridge between Scotland and Greenland, stood at at an average of nearly 3000 feet higher than they do to-day, so that the whole region remained dry land, and Gaul as still joined in this way to Scandinavia and North America.

Above this high level the Scottish Highlands and the Welsh peaks rose to a height of some 7,000 feet, having since been worn down to half that height by rain and ice. Many of these great mountains, thus standing nearly as high above sea-level as the Alps, were active volcanoes; and this chain of volcanoes, of which Hecla is now the most famous remnant, extended across the Atlantic ridge, all the way from Wales to Greenland, which was then covered with a luxuriant vegetation of oaks and chestnuts, vines and magnolias. In the earlier part of the Miocene age the general climate of Europe resembled that of Algiers or Louisiana at the present day, but at the close of the period it had become somewhat cooler, though still subtropical Gigantic conifers, like the famous trees of California, 400 feet in height and 25 or more in thickness, flourished all over Europe, from Italy to Norway. Along with these there were cycads, fan-palms, palmettos, figs, laurels and myrtles, poplars, lindens and maples, acacias and elms, camphors and cinnamons and sandalwood; while ivies and bignonias grew in luxuriance. Cranes, flamingos, and pelicans were common, as also geese, herons, pheasants, paroquets, and eagles. But the mammals, in this as in the preceding epoch, present the most instructive subject of study. Opossums were still present, but had vanished before the middle of the period; and a few existing genera of placental mammals had come upon the scene. There were tapirs and small rhinoceroses, as well as squirrels, moles, and hedgehogs, and carnivores similar to the weasels and civets. Collateral ancestors of the deer and antelope roamed about in large herds, and by the middle of the period had begun to acquire small horns and antlers. In mid-Miocene times the anchitheres disappeared, and were succeeded by the hipparion, much nearer in structrue to the horse. The mastodon came in about the same time, and with him another elephant-like creature, the deinotherium, who lived in the water like a hippopotamus. Carnivores of the cat family reached their highest point of development as regards size and power in the middle and upper Miocene: the machairodus, or sabre-toothed lion, was much larger and more formidable than any lion or tiger now existing. The same period witnessed the arrival in Europe of true apes and baboons, and even of two species of anthropoid ape, allied to the gibbons, one of which, the dryopithecus, was as large as a man, and has been regarded as in some respects superior to any modern anthropoid ape.

Mr. Boyd Dawkins—to whose admirable treatise on Early Man in Britain, the present article is under great obligations—argues forcibly against the probability that man occupied Europe during any part of the Miocene period. All the

species of Miocene land mammals, and several of the genera, are now extinct: and Mr. Dawkins urges that if man existed at that remote period it is incredible that he alone should have subsisted unchanged amid the destruction or metamorphosis of all other species. But it seems to me that Mr. Dawkins partly answers this argument himself when he observes that, "were any man-like animal living in the Miocene age he might reasonably be expected to be not man, but intermediate between man and something else, and to bear the same relation to ourselves as the Miocene apes, such as the mesopithecus, bear to those now living, such as the semnopithecus." Why may not such a semi-human man have existed in the Miocene age, the race having undergone since then changes parallel to those which have affected the apes, or to those which have affected generally such Miocene genera as have survived down to our times? No remains of any such creature have been found, but it is indisputable that artificially chipped flints and the artificially cut rib of an extinct species of manatee have been discovered in mid-Miocene strata in France. Mr. Dawkins is inclined to adopt M. Gaudry's suggestion that the flints may have been chipped and the rib cut by the great man-like ape, the dryopithecus; for although it is not known that any existing apes are in the habit of chipping flints or cutting bones, yet it is not impossible that the dryopithecus may have somewhat surpassed the present apes in intelligence. On the other hand, M. de Mortillet regards these relics as conclusive proof of the existence of man in mid-Miocene Gaul. The question can hardly be decided at present.

But it does not seem to me that Mr. Dawkins' line of argument, which is so conclusive when applied to the Eocene age, is equally conclusive when applied to the Miocene. At an epoch when there were no true apes as yet to be found, when even the lemurs bore marks of kinship with the ancestors of ruminants and pachyderms, and when the carnivorous type was but half developed, it would clearly be idle to expect to find traces of man. But at an epoch when many modern genera had come into existence in all the principal orders, and when in particular there existed an ape as high, or higher, in organization than the modern chimpanzee or gorilla, I can see no such overwhelming improbability of the existence of man himself. No doubt, however, if the remains of Miocene man are ever to be found, they will disclose a type of humanity quite different from, and very likely much lower than, any that we now know. It is not at all improbable that such remains will by and by be discovered in some part of the earth, if not in Europe. By the time the strata of Africa have been explored with anything like the minuteness with which those of France and England have been examined, we shall be very likely to meet with clear indications of the former presence of half-human man, and it will not be strange if such indications lead us far back into the Miocene epoch.

In the Pliocene period the geographical structure of Europe began to be much more like what it is to-day. Hitherto, during the greater part of the Tertiary epoch, large portions of Russia and Siberia had been submerged, so that the continent of Asia did not extend nearly so far north as at present. A belt of

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sea appears to have stretched from the eastern Baltic across to the Persian Gulf, including the areas of the Black and Caspian seas; and another wide channel seems to have run west of the Ural Mountains, connecting the Caspian area with the Arctic Ocean, so that the warm waters of the Indian Ocean found a free passage to the very shores of Finland and Scandinavia. According to Prof. Archibald Geikie, these shallow seas disappeared early in Pliocene times, leaving the Aral, Caspian, and Black Seas in something like their present isolation. While eastern Europe thus began to acquire its present contour, equally remarkable changes occurred at the same time in the west. The Atlantic ridge between Britain and Greenland was submerged, thus separating Europe from America, and the connections of Norway with Spitzbergen on the one hand and Scotland on the other were also severed by the encroachments of the North Sea. But the British Islands were still joined to each other and to the Gaulish mainland; the whole of Britain jutting out from the continent as a great triangular peninsula, with the Shetlands in its apex. The volcanoes of northwest Britain gradually lost their fires during the Pliocene age. Icebergs appeared in the North Sea, and the general climate of Europe, though still milder than to-day, was much colder than it had been during the Eocene and Miocene epochs. The vegetation began to lose its subtropical aspect. Bamboos, evergreen oaks, and magnolias still mingled with maples, willows, and poplars in the latitude of Lyons, but the cinnamon-trees and palms became restricted to Italy. Among mammalia, the first species that has continued to live down to the present time, namely, the African hippopotamus, appears in the upper Pliocene strata of Auvergne. The earliest true elephant, though of a species now extinct, appears at about the same time; and contemporary with him were two species of mastodon, of enormous size, a rhinoceros, a tapir, two or more bears, the giant sabre-toothed lion, an ancestor of the panthers and lynxes, and two kinds of hyæna. There were many species of deer, with antlers, but for the most part unlike modern deer. The ox appears first in the upper Pliocene, but without horns. There were also wolves, and swine, and two kinds of ape. The hipparion still lived, but was becoming scarce, and along with him existed a horse, less specialized in teeth and feet than the modern horse.

Now from the fact that of these Pliocene mammals every one has long since become extinct except the hippopotamus, Mr. Dawkins again proceeds to argue that it is not likely that man inhabited Europe at that period. The alleged instances, three in number, of the occurrence of human remains in Pliocene strata of France and Italy he pronounces unsatisfactory; and he does not even mention the brilliant investigations of the Geological Survey of Portugal, which have brought to light flint implements, of undoubted human workmanship, in great abundance in the Pliocene strata of that country, buried under 1200 feet of superincumbent rock. These discoveries, set forth by M. Ribeiro in 1871, are cited by Professor Whitney as furnishing conclusive evidence of the presence of man in Portugal during the Pliocene period. In his admirable memoir on The Auriferous Gravels of the Sierra Nevada, Professor Whitney has collected a great

amount of evidence which seems to prove that man existed in California at an equally remote date. Now it is perfectly clear that the human race must have been in existence for a very long time before it could have become so widely dispersed over the earth as to occupy countries so distant from each other as California and Portugal. For the first appearance of man on the earth we must, therefore, go far back in the Pliocene period at any rate; and if we are to find traces of the "missing link," or primordial stock of primates from which man has been derived, we must undoubtedly look for it in the Miocene.

Of the three stages of the Tertiary period here passed in review, we have seen that the Eocene was characterized by the entire absence of genera and species of mammals identical with those now living; in the Miocene there were genera, but no species, identical with those now living; in the Pliocene there was at least one species in Europe that has survived to the present day. When we come to the Pleistocene age, we find a majority of the species identical with such as still exist. But in regard to this Pleistocene fauna there are some curious circumstances, which show that the climate of Europe had begun to be subject to vicissitudes such as it had not known in the earlier Tertiary epochs. Among the Pleistocene mammals of Europe we find such as are characteristic of warm climates,—as the lion, leopard, hyæna, elephant, rhinoceros, and hippopotamus; and along with these we find such as characterize sub-arctic climates,—as the musk-sheep, reindeer, glutton, arctic fox, ibex, and chamois; and yet again we find such denizens of the temperate zone as the bison, horse, deer, wild boar, brown and grizzly bears, wolf, and rabbit, to which may be added the mammoth and woolly rhinoceros.

Now, as Mr. James Geikie has ably shown, this singular juxtaposition of northern, southern, and temperate forms points directly to great vicissitudes of climate. It is quite clear that when the reindeer came down as far as southern France, the climate must have been very different from what it was when the hippopotamus bathed in the Thames. We know otherwise from purely geologic evidence, that the Pleistocene climate was very extraordinary. Hitherto, during the Tertiary period, the temperature of Europe seems to have been steadily but slowly decreasing, from the Eocene epoch, when it was subtropical, to the end of the Pliocene, when it was temperate, though warmer than at present. But in the Pleistocene epoch there were at least four or five, and probably several more, extreme changes from a warm to a cold climate, and back again. This period, or the greater part of it, has been known as the "Glacial Epoch" or the "Great Ice Age"; but recent researches have shown that over Britain and central Europe there were several glacial epochs, alternating with warm inter-glacial periods of long duration. When the cold was at its maximum, the whole area of Finland, Scandinavia, and Scotland, with the North and Baltic Seas, was buried under a stupendous sheet of ice, varying from 1000 to 2000 feet in thickness; and this ice-sheet sent off glaciers as far east as Moscow and as far south as Dresden, while the Alps, the Pyrenees, and the mountains of Auvergne became centres of glaciation, inferior, indeed, to the great northern ice-sheet, but still immense in

extent. While the climate of Pleistocene Europe thus came to be similar to that of modern Greenland, parallel phenomena were occurring all over the northern hemisphere. The continent of North America was deeply swathed in ice as far south as the latitude of Philadelphia, while glaciers descended into North Carolina. The valleys of the Rocky Mountains supported enormous glaciers, and the same was the case in Asia with the Himalayas. It was during these recurrent periods of arctic cold that the reindeer and musk sheep found their way to the south of France, while over land-bridges at Gibraltar and Malta the leopard and elephant retreated to Africa. In the intervals between these glacial periods, when the climate became milder than it is at the present day, the arctic mammals traveled northward again, while the lion returned to chase the bison and elk in the forests of Yorkshire.

As the result of these prolonged and repeated climatic vicissitudes, and of the complicated migrations entailed by them, many of the Pliocene mammals still living in Europe at that time have become extinct,—such as the gigantic beaver, the cave-bear, the sabre-tooth lion, five species of deer, three species of elephant, and two of rhinoceros. One race of men—known as the "men of the river drift"—had taken up their abode in Europe when these great changes were beginning, and struggled with the extremes of climate like their enemies, the bears and hyænas. The discovery of flint knives has abundantly proved that man was living near the site of London before the big-nosed rhinoceros had become extinct, and before the arrival of the musk-sheep and the marmot in the valley of the Thames heralded the slow approach of the northern ice-sheet. But the fact that human remains of a date even more remote than this have also been found in Portugal and California shows, as I have said already, that man was then no new-comer upon the face of the earth, but must certainly have been in existence for many thousands of years, though as yet we are unable to assign either his primeval habitat or the precise epoch of his first appearance.

This "man of the river-drift" seems to have become extinct during the Pleistocene period, like the great mammalia above mentioned; and his place was supplied by a hardier race from the north,—the so called "cave-men," of whom the modern Esquimaux have been thought to be a surviving remnant. Of the Arrival of Man in Europe, and of the probable antiquity of this era of recurrent ice-sheets, at the beginning of which he made his appearance in Gaul and Britain, I shall have something to say in another paper.—*Atlantic Monthly*..

FOSSIL MEN AND THEIR MODERN REPRESENTATIVES

Under the foregoing title, Principal J. W. Dawson has published, through Dawson Brothers, of Montreal, an "Attempt to illustrate the characters and condition of prehistoric men in Europe, by those of the American Races." In this volume we have really two books, upon entirely different subjects. What we may call book first is a parallel between the ancient town of Hochelaga, discov-

ereed by Cartier in 1534, and occupying the site of modern Montreal, and the ancient stone people of Europe. The author's opportunities for following up a line of investigation initiated by Sir John Lubbock have been exceptionally good and he has not failed to use them, supplementing the data of Hochelaga with facts collected among our present red Indians. In the course of the argument the author throws out some pregnant suggestions; as, for example, the impossibility of maintaining the definite nomenclature of archæology popular ten years ago; the similarity of the oldest populations of Europe, the river drift and the cave men, to American aborigines; the identity of Schoolcraft Allegans with the Mound-Builders; the anteriority of polished stone to rude stone folk; the spoke-like burial in the mounds as an imitation of lying in a teepec with the feet to the fire; the communal characters of the Swiss palafittes; the totemic significance of the engravings on bone in the European caves, etc. The portions of the volume designated here as the second book, are an argument to prove that all the events indicated by the discoveries of archæologists, in river drifts, in caves and in lake deposits, occurred in a few thousands of years. Without trying to follow Dr. Dawson in his discussion, it is but fair to say that his profound knowledge of palæontology has enabled him to present the brachy-chronic view of archæology more forcibly than Mr. Southall or any other recent writer who has made the attempt.

EOCENE FISHES OF WYOMING.

At a meeting of the New York Academy of Sciences, held December 1, 1881, President Newberry exhibited some very fine quartz crystals from Herkimer Co., N. Y., and also two slabs of perfectly preserved fossil fishes from the extensive Eocene formation of Wyoming Territory. This formation, which is about 7,000 feet thick, shows evidences of three successive deposits, and is exceedingly rich, not only in the remains of fishes, but of birds and mammals. The abundance of fish remains is accounted for by the supposition that the fish were overtaken by some sudden disaster, by which great numbers perished at the same time; that they floated for a while on top of the great lakes they inhabited, and eventually sank to the bottom. The occasional great mortality of fish in the Gulf of Mexico, where the decaying remains sometimes cover a very large area, to the great annoyance of travellers, furnishes an analogy to these prehistoric catastrophes, and suggests the explanation that they were caused by the evolution of poisonous gases from the bottom during volcanic eruptions.

Captain Blake stated that, during the great eruption of Mauna Loa, in 1841, the surface of the water was covered with dead fish for miles. Dr. Martin suggested that numbers of small fish frequently perish near the shore by being cut off in lagoons left by the receding tide. As the water evaporates the fish are brought more and more closely together, until, finally, there is not sufficient water to keep them alive.

BENEVOLENCE FOR SCIENCE.

B. B. Redding, a San Francisco gentleman, recently made the Academy of Sciences of that city a present of $20,000, which he designated as a permanent fund, the interest of which is to be applied to aid students in original investigations in all branches of science in California, Nevada, Oregon and Arizona.

Referring to the above we call attention to the following appeal for aid for our own Academy of Science, which we clip from the *Mid-Continent*:

"Is not the time approaching when the friends of science in Kansas City will remember the Academy of Science in a substantial manner by way of bequests and legacies? Organized December 2, 1875, it has already shown an earnest of what it might do had it more means at command. The Academy has two functions: to increase and to diffuse a knowledge of science. As Kansas City has no institution of learning of a higher order, there are but few original observers in our midst. Prof. Nipher when here, said: 'People in great cities are too busy to think.' The Academy has naturally drawn in the popular element, and done more to diffuse than increase a knowledge of science. Many valuable papers have been read, some of which have been published in Europe. The best talent in the city, and in Kansas and Missouri, has been engaged by the Academy. Prof. Proctor and Col. Fairman, the two leading lecturers in the world in their respective departments, have lectured under the auspices of the Academy. The Academy has also done some original work in the way of observation and investigation. The discovery of the Clay County mounds, and their subsequent development, would have honored any veteran society.

"But the work of the Academy so far has been carried forward by a few devoted friends of science. It has struggled for an existence and been dependent on the annual fees. It needs a permanent fund and a home to do substantial work. It needs a cabinet, a museum and a library. It wants appliances to illustrate scientific lectures. It needs means to publish its transactions. It wants funds to cary on original investigations and observations. It needs a scientist as secretary, who can devote his whole time in making collections.

Such an Academy in Kansas City would exert a powerful influence over the whole city. Men in the whirl of commercial centers need to have their attention arrested and directed to higher and nobler themes. We need to put ourselves in connection with the world of thought and attract hither distinguished scientists. The fresh currents of scientific thought are thus brought and find their way through lectures and papers to all inquirers, and are diffused by the press so as to reach every home. Has not the time come for the benevolent in Kansas City to remember their Academy? The Kansas Academy has been provided for by the State, and given a place in the Capitol building. The Philadelphia Academy has probably a million of dollars invested in buildings and collections. This is also true of other Academies. A benevolent lady in Kansas City has endowed an opera-house. Is there not some benevolent person in Kansas City who will do so much for science—one of the noblest objects of benevolence in the world.

GEOLOGY.

ARCHÆAN ROCKS OF MISSOURI.

BY G. C. BROADHEAD.

This includes the Granites and Porphyries and their associated and intrusive beds in Southeast Missouri. The granites are generally coarse-textured, feldspathic and quartzose, deficient in mica; are red or else of various shades of gray light or rich gray, or blending into a reddish gray. They crop out in massive beds in the northern portions of Iron and Madison and the southern part of St. Francois County, with isolated exposures in St. Genevieve and Crawford. They afford our best quality of building stones. In some localities we find evidence of disintegration and decomposition on a grand scale, as for example, eight miles west of Fredericktown. At this place Mr. A. Tucker sank a well seventy five feet deep passing through granitic sand.

At Lloyd's, in the western part of Madison, south of Blue Mountain, are also found evidences of considerable disintegration. These are probably due to chemical causes and must not be brought forward as evidence against the general use of granite. A majority of the outcrops show massive beds with no disintegration. We must also remember that these rocks have been exposed to the action of the elements through a long course of ages, and viewing them thus, we find that the disintegration of more recently formed rocks is much greater.

The phenomenon of rocking stones is finely exhibited near the Ozark granite quarries, four miles southwest from Iron Mountain, while other beds near by are firm and appear resistless to the continued action of atmospheric agency.

In the northern part of Madison County, east of St. Francois River, granite appears over an undulating district, generally of a gray color, porphyritic near the Iron Mountain Railroad. West of the St. Francois River the red granite rises into mountain peaks, as Huckleberry Mountain, Bellmar Mountain and Stone Mountain. The latter on the south is a porphyritic granite. A syenitic granite forms a "shut-in"* on the St. Francois River near the Einstein Mines, and forms the "rapids" on the river. At this place it is traversed by a dyke of black dolerite forty-four inches wide, bearing S. 60° W. A few miles north, on the banks of St. Francois River the granite contains numerous specks and scales of micaceous iron and also much iron pyrites. We find it here overlaid by horizontal beds of sandstone and conglomerate.

* "Shut-in," a local term signifying that steep rocky cliffs approach close to each bank of the stream.

A half mile west the granite is traversed by a narrow dyke of black dolerite eleven inches wide at the north end and four inches at the southern end. From the north end it bears South 32° West, for thirty feet, thence it gradually curves to South 82° West, a distance of five feet. The adjacent granite wall has been slightly darkened and indurated by contact.

At the Lloyd place, in Sec. 15, T. 33, R. 5 E., a shaft in decomposed syenite has revealed a vertical dyke eighteen inches wide bearing northeast and southwest. Two hundred feet northwest another shaft reveals a north and south dyke of similar rock two feet wide. The dyke is of a gray dioritic character. A quarter of a mile east there is a greenstone dyke eight feet wide bearing a little west of north. At King's, a mile northeast, there is a small vein of specular iron bearing northeast in decomposed granitic sand. A similar vein cuts a red syenite in Sec. 29, T. 34, R. 6 E., and bears N. 15° W. Near King's and at Lloyd's, washings in the roads reveal a good deal of black, shiny particles of magnetic iron sand. The sands of Lloyd's shaft will wash out a good deal of this sand. Similar sand has been found at many places in the northern portion of Madison, Iron and Reynolds, and also in St. Francois County.

In the southern part of St. Francois County, west of St. Francois River, a pit has been sunk on a rich deposit of micaceous iron, which being very soft was at first supposed to be graphite. The granite is also sometimes traversed by quartz veins as in Sec. 2, T. 33, R. 5 E., and in Sec. 6, T. 33, R. 6 E., also on Cedar Creek, where quartz crystals measuring over six inches in diameter have been obtained.

At the Einstein silver mines in Madison County, the rocks indicate an association of diorite and serpentine. The exact position and relation of the beds could not be ascertained, as all work had been suspended, but the specimens left on the ground were of serpentine, green and violet-colored fluor, white quartz, argentiferous galena, wolfram, iron pyrites and zinc blend. The massive rocks at the river are red and gray granite, with red porphyry just west.

Only recently has much attention been directed to the quarrying of granite. This industry is yet in its infancy, but, at present, is indicative of increasing activity. A demand is growing in St. Louis for good material for street-paving, and as the city grows so will this demand. Granite is now being placed upon several streets, and new quarries are being opened in the granite district. Washington avenue and Broadway, at end of the St. Louis bridge, has been paved for six years or more with granite blocks, and the paving is good yet. Polished columns of the Singer building, McLane's building and several others are of Missouri granite. The counter, columns and panels of bar-room of the Southern Hotel, St. Louis, are of Knob Lick granite and are very handsome. Missouri granite has also been used in the Custom House and St. Louis bridge.

Feldspar from the St. Genevieve granite quarries has been used for several years in the glazing of certain iron-ware. At the Insane Asylum, St. Louis, the borings, after passing through 3,400 feet of Palæozoic rocks, penetrated red granite. Extensive arrangements for quarrying have been made at the quarries near

Knob Lick, St. Francois County, and the Ozark quarries near Iron Mountain. At the Knob Lick quarries active work under the present owners began October, 1880, and for the year beginning then the product amounted to $100,000. These quarries now belong to Allen & Smith.

Porphyries are often exposed in Madison, Iron, Wayne, St. Francois and Reynolds, and from the highest peaks in those counties, being elevated from 200 to 660 feet above the valleys. The foot of these mountains is generally flanked by porphyritic conglomerate, or else limestone and sandstone of the Potsdam age. The testimony of the rocks goes to show, that, previous to the formation of the sandstone and limestone, the country presented the appearance of rough porphyry knobs rising 1,000 to 1,500 feet above the sea. In these depressions was the Potsdam sea, in its early ages quite tempestuous, as evidenced by the conglomerates and coarse sandstone, chiefly formed of eroded fragments from the Archæan. These sandstones occupied the shore line of the Potsdam sea. In the course of time these waters became more quiet and calcareous sediments with occasionally sandy matter were formed; but observation shows that this deposit in no place extends along the Archæan slopes over 350 feet above the present valley.

These porphyries in their typical and most common form seem to be a fine-grained impalpable mixture of orthoclase and quartz, generally of a red, brownish or purple color, sometimes dark gray or black; are porphyritic chiefly from the presence of feldspar crystals and often of grains of crystallized quartz. Most of the porphyries on their edges show a shade of red. Many of them are banded and show cleavage planes, and in some we find well marked lines of stratification, and some even show ripple marks indicating a sedimentary origin. At Pilot Knob the porphyry incloses rounded pebbles. Epidote, hornblende and serpentine occur, also beds and veins of specular iron, represented on a large scale at Pilot Knob, Iron Mountain and Sheppard Mountain; being magnetic at the latter place.

Slate, resembling in character roofing slate, occurs on Buck Mountain, Iron County. Dykes of diorite and dolerite sometimes occur.

At the so called Tin Mountain, in Madison County, the porphyry is traversed by coarse dioritic dykes and black dolerite. On the waters of Captain's Creek a dyke of coarse syenitic greenstone seventy-five feet wide cuts the porphyry.

In Sec. 16, T. 32, R. 6 E., there is an interesting exhibit of a series of dykes traversing dark porphyry (see figure 8 Mo. Geol. Rep., 1874). Against the porphyry wall on the east is ten and a half feet of greenstone, next west are a few inches of dolerite, then four feet of porphyry, then two feet of greenstone, then porphyry. The course of dyke is S. 45° W.

In Iron County in Sec. 9, T. 32, R. 4 E., a dyke of hornblende rock can be traced north and south for one-eighth of a mile; it standing several feet above the surface of the ground, like a wall.

On Gray's Mountain in Wayne County and in the southeast part of Iron County we find exposed beds of "Steatite."

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In the northeast part of Reynolds County and northern part of Madison County eruptive porphyry has been found of a gray color and containing large crystals of white feldspar.

Near Polks' in Iron County are found amygdaloidal rocks flanked with porphyry. The Amygdules are of a white mineral. A few miles southward the porphyry contains blue crystals.

There is a good exhibition of a dolerite dyke in porphyry on Mine La Motte property at the Jack diggings. Another dyke is at a cave on Rock Creek.

The porphyries are generally very hard and difficult to work, so it is not probable that they will be used very soon except for paving purposes. The porphyries are of course very difficult to polish on account of their hardness, and necessarily will be expensive to polish; still in the future some of us may expect to see polished columns of Missouri porphyry.

There were on exhibition at the Centennial Exhibition, Philadelphia, several fine exhibits of porphyry polished columns; one inlaid table of red porphyry was valued at $7,500. This was from Elfdalen, in Dalecarlier, Sweden. It was of a dark red color and very much resembled some Missouri porphyrites. Similar porphyry is also found in eastern Massachusetts.

Having closely examined certain porphyries of Massachusetts, New Brunswick and Wisconsin, I find them all to resemble ours of Missouri. If specimens from these different localities were thrown together with a lot of Missouri specimens of porphyry, one at a glance would be inclined to say they were all from the same place. Dr. T. Sterry Hunt at various times has assigned these to the age of the Huronian. T. B. Book also assigns those of Lake Superior to same age. I thus am inclined to believe our porphyries to be of Huronian age. The granites may be older, they may be Laurentian. The trap dykes of dolerite, etc., are of an age more recent than either the granites or porphyries, and are probably of synchronous age. They are intrusive in both the granite and porphyries.

THE VALUE OF OUR COAL ANNUALLY.

The coal production of the United States for the year 1881, is estimated by competent judges to amount to seventy millions of tons, and counting the cost of mining and preparation for market, royalty or ground rent, and, a reasonable profit for the miner, as aggregating on an average $2 per ton, the output representing an actual value at the pit's mouth of one hundred and forty millions of dollars. The cost of transportation to market may be counted at an average of one and a half cents per ton per mile, which, for an average haul of 150 miles, would make say one hundred and fifty-seven millions of dollars for the whole amount delivered to consumers. Adding to this the expense of marketing, commissions, interest, etc., which may be placed at fifty cents per ton, and we have the actual cost of our seventy million tons of coal to consumers as nearly three hundred and thirty-two millions of dollars. From the mean value of about $4.75, the cost

varies greatly. At some points where large consumers mine their own coal, the cost to them is even less than sixty cents per ton, while small consumers at distant points have to pay at times as much as $9.50 per ton, as may be seen in our regular trade reports.

Our gold and silver mines turn out annually about seventy-five million dollars worth of the precious metals, or only a little more than one-fifth of our coal industry. According to Mr. James M. Swank's preliminary census report, the value of the products of the iron and steel works of the United States was close upon three hundred millions of dollars—less, therefore, than the value of the product of our collieries. Our farmers raise annually about three hundred millions of bushels of corn, which, bringing at an average one and a quarter dollars a bushel, makes the average value of the crop three hundred and seventy-five millions of dollars, or about forty millions more than the sum realized by the sale of "black diamonds." Directly and indirectly, in the mining, transportation, and distribution of coal, the trade supports more than four millions of our people.—*Coal.*

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, February 27, 1882.

The scientific world here is very much occupied with the subject of nervous affections; also, of the curious phenomena to which they give rise and that may be included under the generic titles of hypnotism and magnetism. Dr. Dumontpollier, of the Hospital de la Pitie, has conducted some very interesting experiments upon patients, calculated to throw not a little light upon those complex phenomena vaguely denominated animal magnetism, somnambulism, etc. It is necessary to separate the true from the false in mesmerism. The subjects operated upon in the Hospital de la Pitie, suffer from nervous disorders more or less complex. Some have one side of the body insensible, others the entire system so affected that they can be cut or burned with impunity. Often they appear in a cataleptic condition, that is, the members, while retaining their suppleness, remain in the position imparted to them. Very singular attitudes can thus be given.

There are patients with whom the lethargic state arises suddenly and continues during several hours, days and even weeks, while again with others the nervous attacks are of a most extraordinary energy; the members contract in such a manner as to display frightful contortions; often the body is bent in two like the arc of a circle, with the head and feet for points. Occasionally there is an excess of gayety or of fury; of eccentric attitudes and startling hallucinations.

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While these phenomena are peculiar to the hysterical and cataleptic, it would be erroneous to deny their existence, attenuated of course, in persons of sound health. The human organism rests on the extreme limit between disease and health, and a mere nothing can compromise the equilibrium.

Dr. Charcot has demonstrated that the cataleptic and sleeping states can be induced at pleasure, in the case of hysterical epileptical individuals, by means of physical agents, as the influence of light and sound, for example. A ray of light striking the eye, a look even, the tick of a watch, etc., sufficed to determine the cataleptic condition, where the patient became insensible over the whole body; the members retained the position in which they were placed, the visage reflecting the expression of the gesture. If the features displayed a tragic air, place the hands in the attitude of prayer and the expression became softened.

So long as the light strikes the eye, the cataleptic state continues, but interpose a screen between the eye and the light, or simply close the eyelid, and the catalepsy disappears as by enchantment. the members, raised or folded, fall inert, and if the patient be in an upright position he will tumble. Then the magnetic or somnambulic sleep ensues, or what is more correct, a condition of lethargy—total and absolute. But there is produced at the same time a degree of muscular excitability very extraordinary. The slightest touch of the skin induces contractions more or less energetic, which latter resist the most violent efforts to undo; the arm rises up, the leg contorts, the fingers close, despite every effort to oppose these movements. The operator cannot give, as heretofore, what position he pleases to a member. The slenderest touch, and the muscle acts against everything, as if set in motion by a hidden spring.

While in this condition the patient's intelligence is frequently excited also: he comes when commanded; sits down, gets up, kneels; obeys, in a word. But he will never knock against any article of furniture, having the appearance of being protected by second sight. To terminate this state, it is only necessary to blow on the face of the subject, who is seized by spasm of the throat, bringing froth to the lips, then full awaking; but no remembrance of what had occurred. M. Descourtis maintained one eye of a patient under the influence of light and closed the other; results: one-half of the body was cataleptic, the other lethargic.

Connected with this matter is the application of pieces of certain metal to the surface of the body to restore sensibility. Dr. Burg has identified himself with this study since 1862, and has obtained very strange, but important results. Some patients are more impressed by one metal than another. If a small plate of copper be placed on the affected limb of a person insensible in one-half of his body, and the flesh pricked, the patient will feel in the part hitherto insensible, while the same portion of the other, the healthy limb, will become devoid of sensibility. These effects are but transient, and demonstrate that what is gained on the one side is lost on the other. Identical results ensue with feeble currents of electricity suitably applied.

A patient was admitted into the Pitie hospital, absolutely insensible to pain; plates of platina and of silver were applied, but no sensibility was provoked. I was remarked, that the patient wore a silver ring; the doctor pricked the part of the finger covered with the ring, and immediately the patient started. Silver alone could not produce that sensibility, as it had been already tried. The ring was then analyzed, and found to be an alloy of copper. Copper and silver plates were then applied to the forehead and the umbilical region, strange as it may appear, when the whole body gradually became sensitive.

In the lethargic state, the patient is in a very high degree of nervous irritability: a fly touching his skin, can induce contractions; even the slightest vibrations induce a movement in the whole nervous network, similar to that which takes place when fulminating matters explode under the influence of determined vibrations. Judge: the patient is in his hospital bed; he is sensitive on one side of the body, cataleptic on the other: by means of a mirror, a ray of light is thrown on the muscles of the sensitive leg, by these, to us invisible mechanical vibrations, the limb trembles, slowly rises up, the abdomen inflates, the contraction arises at its maximum, the abdomen swelling, despite a weight of 224 pounds placed thereupon; then the contraction diminishes, the abdomen lessens in volume, the tetanic stiffness disappears. The vibrations of light which produced these phenomena, also induce their cessation.

Heat, cold, sound, a magnet, even a common bellows will produce the same effects as light; the patient thus resembles a puppet; the members, if cataleptic, can be placed in any posture, the other moiety of the body, if sensitive, can be contracted to a very high degree; indeed one half of the face can be made to look tragical, and the other gay.

With some patients, Dr. Dumontpollier, by blowing on certain parts of the forehead, or by a steadfast gaze, or approaching with his finger, causes them to immediately lose all faculty of speech and ability to write. Also, the patient can be made to lose all notions respecting the use of certain objects. Many of these phenomena are produced by mesmerists, magnetizers, etc., but strip the latter of their empiricism, their passes, their mystery, and it will be seen that, as science reveals, they are determined by physical agents. It cannot however be positively affirmed that the phenomena are absolutely produced independent of will.

The hospital experiments were conducted on persons laboring under nervous diseases; could the same be made on individuals in robust health? If it be borne in mind that disease creates nothing; morbid phenomena being only the modifications of physiological functions. Very slight causes can make a person pass from good health into sickness. In this age, especially in large cities, there are but too many on the frontiers in question; nervous systems are over-excited, overtaxed, especially between the ages of fifteen and twenty-five. Such individuals are fit subjects to be plunged into the cataleptic or the lethargic condition. The latter depends on convulsing the eyes; convulse the eyes and sleep is induced; the cataleptic stage follows. Such subjects, mesmerists class as "sensible:" they pass as robust, when in fact their nervous system may be out of joint. Once

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lethargized, the subject between the hands of the magnetizer becomes simply a puppet. It is the realization of Descartes' automatism; the individual receives a glass, and is told to drink what one wishes; the glass induces the sensation which determines the act; then water becomes wine, milk, coffee, potatoes, or apples. It is not the will of the operator which here is in play, but the tendency to imitation on the part of the lethargic.

In an incidental discussion on solar spots, M. Faye reiterated his explanation of the cause and that for him, time only confirms, viz: that the principle of the spots is in the rotary movement of the star itself, and the coolness is produced by that movement even. The evolution of the spots, from one border to the other of the polar and equatorial bands, is due to a tendency to an equilibrium of temperature on the surface of the sun in the end to secure an equal distribution of heat.

Wheat is subject to a malady known as rust or smut; it attacks the grain in the ear, transforming it into a shapeless mass, of a morbid tissue, and destitute of all nutritive qualities. M. Davaine traces the cause of the malady to an eel-shaped worm, which pricks the tissue of the flower, and hence the development of the grain becomes abnormal. M. Braun admits the existence of the worm, but locates its action in the pistil of the flower, thus arresting development. M. Priedieu, last summer, having saved wheat so diseased when the plant came into flower, saw by the microscope the worms pricking the stamina of the flower, at the point of the ovary; the tissue became distorted into a tube which formed the kernel of the blasted grain. Preserved in the grain, the worm regenerates itself in the soil where the diseased grain is sown, and can retain its vitality for twenty-five years.

ASTRONOMY.

SCIENTIFIC CHARLATANISM.

BY PROFESSOR H. S. PRITCHETT.

OBSERVATORY OF WASHINGTON UNIVERSITY,
ST. LOUIS, MO., March 11, 1882.

Your note* requesting my opinion of an article published in the Kansas City *Journal*, and written by Mr. A. M. Blake, of Cleveland, was received yesterday. The five columns devoted to Mr. Blake contain the most incoherent mass of non-

* For the purpose of laying before our readers an authoritative and reliable denial of Mr. Blake's absurd statements regarding a change in the earth's position, which aroused some inquiry at the time of their publication, we requested Professor H. S. Pritchett to reply to them. It will be seen that such sensational stuff meets with very little mercy at the hands of a thoroughly educated and skilled astronomer.—[ED. REVIEW.

sense it has been my fortune to read in some time. The absurdity of his hypothesis and conclusions was pointed out by Mr. McCarty, whose communication was also enclosed.

Mr. Blake's paper, which is made up of glittering absurdities and sensational statements, is so completely guiltless of any argument drawn from either mathematics or physics, that it would be a waste of time to take it up in detail. The very first paragraph betrays utter ignorance of the most ordinary astronomical knowledge, although he signs himself pompously "Astronomer," and in a subsequent communication modestly refers to himself as one of the "wise men" of the country.

Stripping his expressions of superfluous verbiage, he asserts that the attraction of the planets, at the time of conjunction with the sun, has changed the inclination of the axis of the Earth to the Sun (he means, probably, changed its inclination to the ecliptic,) and thereby has brought about a change of zones.

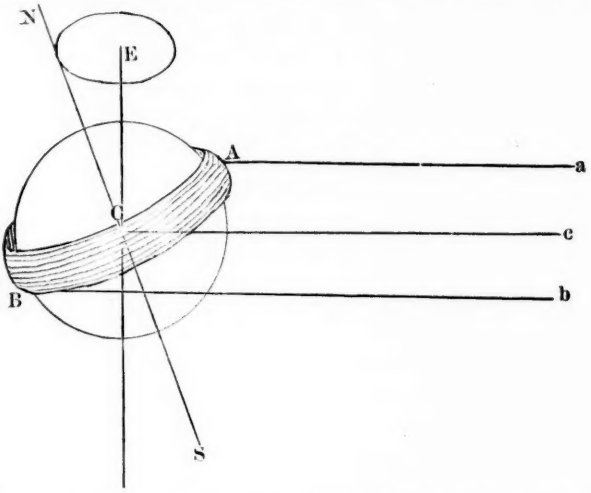
This idea that the attraction of the Sun and Moon and planets upon the Earth would change the inclination of the Earth's equator to the plane of the Earth's orbit, was advanced and refuted many years before Mr. Blake's day. His modesty in claiming the idea as an original discovery may therefore be fully appreciated.

The phenomena which actually occur, due to the attraction of the Sun and Moon on the spheroidal figure of the Earth, are explained in every text-book on Astronomy and may be made clear in a few words even to the non-mathematical reader.

The point where the Earth's axis, when produced, would meet the celestial sphere is called the celestial pole or, ordinarily, the pole. It is the point about which the constellations appear to revolve and at present is near the bright star Polaris, or the pole star. The direction of the Earth's axis is, however, slowly changing from year to year. This change in the direction of the Earth's axis or the corresponding motion of the great circle of the equator upon the ecliptic is ordinarily called the Precession of the Equinoxes. It is due, as was shown by Newton, to the unequal attraction of the Sun and Moon upon the spheroidal form of the Earth, and may be readily understood from the following figure:

If the Earth were a perfect homogeneous sphere the direction of its axis would never be changed in consequence of the attraction of another body. Suppose, however, the excess in matter about the equator to be represented by the ring A B. Suppose a distant attracting body, (the Sun), situated in the direction Cc so that the lines of attraction Cc, Aa, Bb are nearly parallel. The attractive force, being slightly stronger at A than B, on account of its smaller distance from the attracting body, there will be a residual of attracting force which would tend to pull the ring into the plane of Cc, or, in other words bring the equatorial ring into the plane of the Earth's orbit, the ecliptic. In the case of the Earth, however, a modifying force is found in the rotation of the Earth on its axis, so that this residual of attracting force produces a slow revolution of the Earth's axis about a line perpendicular to the direction of the motion, after the manner of

the gyroscope or spinning top. In the figure this would correspond to a motion of the axis NC about the line EC, or, in other words, the pole of the Earth's equator (or the Earth's axis) make a complete revolution about the pole of the



ecliptic. It requires about 25,000 years for the celestial pole to make this revolution. The only effect of one or more planets in conjunction with the Sun would be to increase by an almost infinitesimal amount this attraction. [*See Newcomb and Holden's Ast.*] This motion of the Earth's axis or precession of the equinoxes has been known since the time of Hipparchus. In the time of Hipparchus our present pole star was 12° distant from the pole. The pole has since steadily approached it and will continue to do so till the year 2100, when it will slowly pass by it and at the end of about 12000 years will be near the constellation Lyra.

Although the direction of the Earth's axis in space is thus constantly changing, yet the position of this axis, relative to the crust of the Earth, remains invariable. The idea was advanced many years ago that this motion of precession would result in a change of position of the North Pole on the Earth's surface, so that the northern regions would be covered with ice, as a result of the different direction in which the oceans would be carried by the centrifugal force of the Earth's rotation. Had such a stupendous change taken place in the short space of time allotted by Mr. Blake, it would have been its own messenger of woe, and no prophet or "wise man" would have been needed to announce its arrival.

It has been shown, however, mathematically, that the position of the poles, and therefore of the equator on the Earth's surface, cannot change except by some variation in the arrangement of the Earth's interior. Scientific investigation has as yet shown nothing to indicate any probability of such a change.

It is to be regretted that the newspapers should devote their columns to printing such absurdities as these uttered by the astronomer(?) of Cleveland; the more so because it is printed in all seriousness as the result of real scientific investigation; whereas the entire article is not only absurd and untrue, but the fallacy of the hypothesis was exposed so long ago that it has become part of every college text-book on astronomy.

At the present day two classes of men are engaged in the retailing of scientific sensations. One class may be denominated the scientific fraud. It includes those men who are utterly without scientific training and ignorant of what has been already done, but who by vigorous shouting and the use of high-sounding terms obtain among a certain class a great reputation for learning. Such men may or may not believe the the vagaries they attempt to teach.

The other class is composed of men more or less skilled in science, but who spend their time in writing for the newspapers and beguiling the public with sensational theories. Such men generally suggest much more than they assert and avoid a direct statement. To this class belong those astronomers who keep a convenient comet lurking about the outskirts of the solar system, ready at short notice to plunge into the sun and create a conflagration that shall destroy us all. It may be incidentally remarked that both classes secure more money and more attention from the general public than hundreds of honest workers in science whose work is for all time. It is needless to say that no one could ever suspect the author of the before mentioned article to belong to the second of these classes.

It is to be hoped that the time may come when such men may no longer be able to gain the public ear by ranting over sensational hypotheses which have been exploded years before.

COMETS; THEIR COMPOSITION, PURPOSE AND EFFECT UPON THE EARTH.

BY PROFESSOR LEWIS BOSS, DIRECTOR OF DUDLEY OBSERVATORY.

A few months since Mr. H. H. Warner, of Rochester, N. Y., founder of the Warner Observatory, announced a special prize of $200 for the best essay on "Comets, their Composition. Purpose and Effect on the Earth." One hundred and twenty-five essays were sent in to Director Swift, of the Warner Observatory, and after a careful review, the judges—Professor Elias Colbert, of Chicago, Ill., Professor H. A. Newton, of Yale College, New Haven, Conn., and Professor H. M. Parkhurst, of New York City,—unanimously awarded the prize to the essay signed "Hipparchus III," by Professor Lewis Boss, Director of the Dudley Observatory, of Albany, N. Y. Following is the full text:

Though modern science has taught us much concerning the physical nature of comets, no one has yet been able to construct a theory which is either complete or free from objection. With these facts in view, and so far as possible within

our brief limits, and without the use of technical language, we will endeavor to outline some of the more important results of observation and reflection upon this subject. We shall be obliged to draw freely from the results elaborated during the last fifty years by Bessel, Winnecke, Bond Newton, Zœllner, Bredichin and many others, without reference to individual authorities or digressions upon rival theories and claims.

METEORS—OFFSPRING OF COMETS.

§ 1. About twenty years ago it was proved that certain annually recurring displays of meteors are due to swarms of small bodies, which revolve about the sun in elliptical paths, so situated in space as to encounter the earth at nearly the same time in each succeeding year. These paths or orbits were found to be identical in some cases with those of certain well-known comets. The conclusion seemed irresistible and is now accepted, that shooting stars, or meteoroids, are simply the offspring of disintegrated comets.

Most likely, aërolites (large meteors) which sometimes reach the surface of the earth, are of the same origin. These bodies usually enter our atmosphere with velocities (relative to the earth) ranging from twenty to forty-five miles per second. In consequence of the inconceivable heat which would be generated by such contact—manifested by the fiery train they leave behind—the smaller meteors, however dense, would be at once converted into impalpable vapor. Only the larger ones could survive the tremendous encounter, and reach the earth. Still others, composed of more fusible substance, though very large, may be unable either to overcome the mechanical resistance of the air, or the transcendent heat produced. Furthermore, that fiery ordeal must strip aërolites of all volatile matter and leave only refractory substances behind. Hence, analysis of meteoric stones might give us an idea of the real composition of comets which would be totally misleading; just as the ruins of a house, destroyed by fire, would be no index of the chemical composition of all the material it contained before the disaster.

TESTIMONY OF THE SPECTROSCOPE AND POLARISCOPE.

§ 2. The Spectroscope (light analyzer) rather reluctantly yields some testimony as to the chemical and physical nature of comets. It seems to show that the nucleus is a solid or liquid incandescent (at a glowing temperature) mass. It proves quite conclusively that the matter surrounding the nucleus contains hydrogen and carbon in one of their numerous compounds. The flame of the Bunsen burner, which contains one of the compounds, shows a spectrum (light analysis) which is very similar to, if not identical with, that observed in comets. Some observers have reported that these elements give evidence of their presence in the tails of comets at considerable distances from the head. If so, we must suppose the attenuated matter of the tail to be self-luminous. This may be attributed to some form of electrical action; since, considering the low temperature of space, it cannot be due to incandescence produced by ordinary heat.

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Recent observations with the spectroscope seem to prove that a part of the light from comets is really reflected sunlight, since it faintly exhibits a spectrum like that of other bodies which shine by reflected light alone.

The Polariscope (instrument for detecting reflected light) also gives evidence which leads to the same conclusion. The use of this instrument in examining faint sources of light is attended with great difficulties; and in the present connection, the records of different observers are not strictly harmonious.

RECORD OF THE TELESCOPE.

§ 3. Comets are seen in their simplest form as faint patches of nebulous light. They are usually circular or oval in outline, without remarkable difference of brightness from center to circumference. At a latter stage of development the comet shows a diffused brightness in its central parts, known as central condensation.

When a large comet approaches the sun, the structure becomes far more complex. The center condensation gathers intensity. Finally, a point or disc of light appears near its center, which shines with a light approximating that of the planets. This is called the nucleus.

NUCLEUS HAS NO DEFINITE MAGNITUDE.

Observers with powerful telescopes usually find that what we commonly call the nucleus has no definite magnitude. It continually measures less with increase of optical power. The inference is that the real nucleus, if it consists of a single solid body, must be very small, and much obscured by the vapors which surround it. Generally the nucleus appears to shrink in size as it approaches the sun. The most plausible explanation seems to be, that with lessened distance from the sun, the real nucleus gets hotter and brighter and at the same time the vapors near it become more transparent. Other explanations have been offered which we have no space to consider.

THE ENVELOPES.

We commonly find that the coma (nebulous matter about the nucleus) appears much brighter on the sunward side. In many cases, streams of matter appear to issue from the nucleus on that side. These assume a variety of forms, and are almost always curved backward, from the direction of the sun, at their extremities. Above the streams, or jets are sometimes seen one or more arcs of light, concentric with the nucleus from which they appear to recede,—just as waves recede in widening circles from a stone dropped into still water. These envelopes, as they are called, are supposed to be hollow spherical segments of matter, more dense than the surrounding parts of the coma.

One highly important characteristic of the matter which surrounds the nucleus is well established. The rays of light from distant stars seen through it are not sensibly bent, or refracted. This shows that gases to an appreciable amount do not exist in comets.

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THE PHENOMENA OF THE TAIL.

The strange appearance of the tail and the gigantic dimensions it sometimes attains, are well calculated to arrest the attention of mankind. It is not wonderful that the ancients should have regarded it with trembling apprehension, nor is it surprising that even yet, it excites an absorbing curiosity among the educated, and the superstitious terrors of the ignorant. The matter of which it is composed must be expanded to an almost inconceivable degree; for even when it is millions of miles in diameter, the light of the faintest stars is seen through it with scarcely diminished brightness.

THE BLACK STREAK IN THE TAIL.

Near thh head, it often appears to consist of two streams of matter issuing from either side of the coma with a dark channel of separation between. The tail at this point generally appears to have the same diameter, from whatever direction in space it is viewed. We must, therefore, conclude that its interior is nearly or quite free from matter, and like a hollow cylinder, or portion of a cone, as far as the dark channel extends. Beyond that point we may suppose that the interior fills up by gradual diffusion from the circumference: in some cases, and especially with small comets, the dark channel is wholly wanting, or but faintly indicated.

CURVED DIRECTION OF THE TAIL.

In order to give an idea of the situation of the tail in space, let us imagine a line from the sun continually prolonged through the moving head of a comet into space beyond. We shall always find the tail extending nearly opposite the sun, in the general direction of this prolongation, but curved more or less backward from it, in the direction from which the comet is moving. Sometimes we find more than one tail—each distinguished by the degree of its backward inclination. They have, indeed, been classified on this ground and found conformable to three general types.

ORIGIN OF COMETS.

§ 4. The facts thus far presented, prove nothing as to the origin of comets. That question demands for its solution mathematical reasoning based on the calculated paths of all comets which have been observed. That discussion is beset with great difficulties, and as yet points to no absolutely certain conclusion. The balance of testimony seems to favor the supposition, that comets originate outside the solar system. The planets move in nearly circular orbits about the sun; and no one has been able to show why comets, if they have the same origin, should move in elongated orbits, entirely differing from those of planets.

Let us suppose, however, that all comets must have taken their origin in some primeval nebula from which a solar system has been evolved. It has been shown that the velocity of a comet may be so much increased by the disturbing action of a large planet, that it may escape from the control of the sun, and be projected into the illimitable regions of space. Thus freed, it will go on in a nearly straight line forever; unless, perchance, some powerful source of attrac-

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ion, like another sun, lying near its path, arrests its flight. The possibility of such an occurrence is by no means imaginary. At least one comet (Lexell's, 1770,) is supposed with good reason to have undergone that fate. There is every reason to believe that the same thing may have happened in other cases.

STELLAR COMETS.

All arguments drawn from observation and reflection prove that the stars which surround us on all sides are remarkably like our own sun. Some of them are even larger and more powerful than he. Reasoning from analogy, we must suppose that these suns are also attended by comets. Hence, we are led to the conclusion that uncounted myriads of comets, projected forth from millions of suns, during countless ages past, are now flying through space in every direction —restless messengers from star to star. By mere chance some of these bodies must come under the sun's far-reaching power and be drawn into our planetary system.

PHYSICAL HISTORY OF COMETS.

§ 5. The mass (quantity of matter) of comets is conceded to be very small in comparison with that of the earth. How small it is, we cannot say. No comet has been found large enough to exert a sensible attraction upon any celestial body found in its vicinity. This fact confirms the conclusion derived from telescopic examination, that the real, solid nucleus, if it exists, must be extremely small.

It is certain that no body entirely gaseous could exist in space. The conditions for the stability of liquid bodies in their practical application to the explanation of cometary phenomena, are extremely complicated; since they are closely associated with the unknown elements—mass of the comet, solar radiation, and absolute temperature of space. It would also be extremely difficult to show how a swarm of small bodies could be preserved in a state of equilibrium, or resist the tremendous tidal action to which it would be subjected in the vicinity of the sun. In fact, we must view the conversion of a comet through some unusual catastrophe, into such a swarm, as the sure precursor of approaching dissolution. On the whole, it is probable that there is a solid or partly liquid body near the center of the comet. This body is more likely to consist of an aggregation of loosely cohering pieces or particles, than of a single firmly united mass.

Owing to the smallness of their attractive force, comets cannot retain a sensible atmosphere. This conclusion is confirmed by telescopic observation, as we have seen.

If, now, we suppose the nucleus to be approaching the sun, it will eventually reach a point where the liquid or other volatile matter on the "sunny" side commences to evaporate and be diffused about the comet. Without following the consequences of this evaporation into details, one can imagine for himself how the appearance of central condensation, of the streaming jets, and of the nucleus heavily obscured by vapors, might be produced.

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To account for the backward curvature of the jets and the peculiar form and direction of the tail, we must look for some additional force. In all probability this force resides in the sun, and is directly opposite in its effects to the power of gravitation. But since the body of the comet obeys the law of gravitation with sufficient fidelity, we must find a repulsion which sensibly acts only on the molecules of gas or vapor.

The only force suggested by experience as competent to these requirements is that of electrical repulsion. Any one can prove for himself that two bodies similarly electrified mutually repel each other. We know that the earth, through effects of constant evaporation and other causes, is to some extent an electrified body. For the same reasons, we should expect comets to be electrified in a much higher degree. The sun itself certainly exerts an influence upon terrestrial magnetism. Violent commotions on his surface have occurred at the same time with unusual disturbances of the magnetic needle. Electrical repulsion acts in proportion to surfaces and not to volumes. On particles of matter in a state of infinitesimal subdivision it might act most powerfully, while not affecting a large body to an appreciable degree.

THEORY OF FORMATION OF TAILS.

If, then, we suppose the sun and comets to be sufficiently and similarly electrified, we have the force necessary to produce the backward curvature of the jets, and to drive off the smallest and probably outermost molecules of the coma to form the tail. Since, according to our hypothesis, very little matter can be given off from the shaded side of the nucleus, we readily perceive why the tail should be hollow in appearance.

The orbit of the moving nucleus being curved, it is evident that the particles driven off at any time with less than infinite velocity, would continually fall more and more behind the prolongation of a line through the sun and comet—just as has been observed. If the matter contains molecules varying considerably in size, the larger ones would be driven off with less velocity. These would curve backward more than would the lighter molecules driven off at the same time; and so we have the multiple tails which have been seen, as well as the classification already described. Elaborate examinations of their average observed direction and form suggest that each class may be composed of chemical elements peculiar to itself. We may even venture to suppose that the tail of greatest velocity and least inclination is composed of hydrogen. The second type may contain carbon, with or without other elements; and among those of the third, chlorine would most likely be found.

It is a common error to suppose that this hypothesis, as to the formation of the tail, requires a repulsive force of inconceivable power. The straightest tails which have been observed are accounted for by supposing a repulsive force not much greater than twelve times the sun's attractive power. The tails most frequently seen (scimeter-like in form) may be produced by a force about one-ninth

of that amount, which is but little more than sufficient to overcome the attraction of gravitation.

It will be seen that it is equally erroneous to suppose any great amount of material wasted in the formation of the tail, when one reflects upon the transcendent lightness of its structure.

HOW COMETS AFFECT THE EARTH.

§ 6. The influence of comets upon the earth is in all probability quite insignificant. They may, like the sun, affect the earth's magnetic condition, and and thus to some extent, possibly, its meteorology. No such effect has ever been perceived. In spite of some chance coincidences between the apparitions of great comets and remarkable public events, no well-informed person now believes that there is any real connection between them. By a liberal and credulous interpretation of any frequently occurring celestial phenomenon, similar coincidences could be shown.

When a comet is converted into meteoric bodies, which impinge upon the earth's mtmosphere, there is some direct though probably minute effect. Some have thought that a sensible portion of the heat which the earth receives is generated in this way; but the weight of scientific opinion seems to be against that hypothesis. The impact of meteors upon our atmosphere must add some matter to it, and this is probably in the form of dust. This may be the origin of the so-called cosmic dust, which has been collected at sea in recent times. The finer particles of it may have some influence on cloud formations, and other meteorological phenomena, but all this is merely conjecture.

A more remote effect may be sought in the possible fall of meteors and comets upon the surface of the sun. Owing to his vast bulk, the sun would attract an immense number of these bodies; but it is quite certain that their effect upon the sun's heat is insignificant. It is now generally admitted that we must look for the origin of the sun's heat in a constant, though to us, imperceptible shrinkage of his vast bulk.

Some connection between the frequency of sun-spots and comets has been rather vaguely suspected. Were the search for comets systematically pursued with equal persistence for a long period, we might have some data for the formation of a sound opinion. Yet it would still be an open question, whether comets cause the spots, or whether greater activity of the sun tends in some way to render comets brighter, so that more will be visible—with probability in favor of the latter supposition.

Finally, it may be said with all due respect to scientific decorum, that the appearance of a great comet does exert one most happy influence on the earth, in that it stimulates the curiosity of mankind and directs their thoughts to the more particular contemplation of the glorious universe which surrounds them.

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ASTRONOMICAL NOTES FOR APRIL, 1882.

BY W. W. ALEXANDER, KANSAS CITY, MO.

THE SUN.

Date.	Right Ascension.	Declination N.	Equation of Time.
1st.	00h. 43m.	4° 41′	3m. 49s. +
5th.	00 58	6 13	2 37
10th.	1 16	8 05	1 12
15th.	1 34	9 54	0 04 —
20th.	1 53	11 39	1 13
25th.	2 12	13 18	2 12
30th.	2 31	14 53	2 57

Semi-diameter on the 1st, 16′ 02″; on the 30th, 15′ 54″.

THE MOON.

Date.	Right Ascension.	Declination S.	Semi-Diameter.
1st.	11h. 26m.	1° 29′	14h. 49m.
5th.	14 35	16 57	15 13
10th.	19 13	18 32	15 58
15th.	23 52	4 03 N.	16 29
20th.	4 38	21 06	15 42
25th.	8 57	11 58	14 50
30th.	12 43	8 46	15 05

MERCURY.

Date.	Right Ascension.	Declination S.	M. T. of Meridian Transit.
1st.	23h. 19m.	6° 55′	10h. 36m. A.M.
5th.	23 41	4 42	10 42
10th.	0 10	1 29	10 51
15th.	0 42	2 09 N.	11 03
20th.	1 16	6 10	11 17
25th.	1 52	10 26	11 34
30th.	2 32	14 43	11 54

Apparent diameter on the 1st, 6.2″; on the 30th, 5″.

VENUS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Transit.
1st.	1h. 21m.	7° 37′	00h. 42m. P. M.
10th.	2 03	11 53	00 48
20th.	2 51	16 11	00 56
30th.	3 41	19 47	1 06

Semi-diameter on the 1st, 5.2″; on the 30th, 5.5″.

It will be visible in the west during the entire month, constantly increasing in brilliancy. It will appear nearly round in the telescope.

MARS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Transit.
1st.	6h. 53m.	25° 13′	6h. 12m. P. M.
15th.	7 21	24 16	5 45
30th.	7 52	22 50	5 19

Semi-diameter on the 1st, 3.8″; on the 30th, 3.1″.

It will be in the constellation Gemini, during the entire month. On the 26th it will be in line with Castor and Pollux, at the same distance south of Pollux that Castor is north.

JUPITER.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Transit.
1st.	3h. 33m.	18° 31′	2h. 53m. P. M.
15th.	3 45	19 13	2 10
30th.	3 59	19 57	1 25

Semi-diameter on the 1st, 16.5″; on the 30th, 15.8″.

It will be in Taurus and too near the sun to be observed well.

SATURN.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Passage.
1st.	2h. 38m.	13° 13′	1h. 58m. P. M.
15th.	2 44	13 45	1 10
30th.	2 52	14 20	0 18

Semi-diameter on the 1st, 7.8″; on the 30th, 7.7″.

Elevation of the earth above the plane of the ring 21°. It will be too near the sun to be observed.

URANUS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Transit.
1st.	11h. 7m.	6° 29′	10h. 27m. P. M.
30th.	11 4	6 47	8 29

It will be in a very favorable position for observation, being in the constellation Leo near its eastern edge. The bright star Regulus in the same constellation will be 16° west and 6° north of Uranus, and will guide an observer in finding it. The light we receive from this planet is only equal to a star of the sixth magnitude, and it will require a good eye to find it.

NEPTUNE

Will be too near the Sun to be observed during the month.

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PHENOMENA.

On the evening of the 19th Venus and Saturn will be in conjunction; Saturn ll be to the south of Venus 1° 53′. The moon will be close to Jupiter on the ne evening.

On the 28th, the Moon will pass south of Uranus 6° 17′.

MEDICINE AND HYGIENE.

THE SANITARY LEGISLATION OF THE PENTATEUCH.

Strange as it may sound, legislation concerning public health is not entirely notion of this nineteenth century, sprung from the brain of the Southwood iths and the Chadwicks. Ages before the Society for the Diffusion of Useful nowledge or the Sanitary Institute of Great Britain came into being, we find gulations on sanitary subjects, not merely proposed but formally enacted, insted with the most solemn sanctions of religion, and inseparably interwoven h the customs and polity of a remarkable people. These regulations, which ve attracted surprisingly little notice considering that they are met with in a ok which has, more than any other, been closely scrutinized both by its friends d its enemies, are, we think, not unworthy of attention from a scientific point view. They agree most strikingly with the results of modern research, both the recognition of danger and the precepts laid down for its removal or avoidce, and they are in too many respects far in advance of our actual practice. e propose to examine these laws, not from the position of the archæologist, the entalist, or the divine, but simply from that of one interested in Sanitary ence. If we find that Moses has anticipated certain of our modern oracles, we ll not seek to explain so suggestive—and to some persons unwelcome—a coinence. The question whether or no some of the laws which we shall quote y not also have other and possibly even higher meanings we must leave to be cussed elsewhere. We think meantime that no one who has carefully traced history of the human mind need feel surprised or offended at finding precepts bodily health presented as under Divine sanction.

We will first call attention to the subject of blood. Nothing is more emphatlly and repeatedly forbidden in the Books of Moses than its use as an article food. What is the reason of this prohibition, which, as most people know, is y scrupulously obeyed by the Jews down the present day? Theologians will rhaps pardon us if we submit that this has, in addition to other possible meangs, a physiological import which has in these days been too frequently lost sight even by many medical men. The enactment is surely in complete harmony h the teachings of modern science. We know that the circulatory system has

a double office: on the one hand it serves to convey fresh matter to supply the we and tear of the system, whilst on the other hand it serves to carry off what m be popularly called the waste or refuse of the body. Such refuse is in due cour eliminated by means of the kidneys, the sudiparous glands, etc., and appea then in its avowed character of excrementitious matter. It is, therefore, evide that the blood if drawn off promiscuously, arterial and venous together, contai a certain proportion of effete substances, which are only fit to be expelled, a which are ill-suited for human food. If by any derangement the action of t kidneys is arrested, this refuse accumulates in the blood, and the consequenc at once make themselves felt. Now, as to separate the arterial from the veno blood of a slaughtered animal is impracticable, we contend that to use the bloc as food approximates very closely to drinking urine, and is not merely loathson but *pro tanto* unsafe. That, like liquid and solid excrements, it is valuable f plant-food, and that it serves as a pabulum for certain classes of animals is n proof that it is fit for human consumption.

Even the mechanical state of blood when coagulated is a strong argume against its dietetic use. Unlike flesh, it is not composed of fibres between whic the gastric juice can easily penetrate. It is a solid structureless mass like caou chouc, which can only be acted upon from the outside of each fragment, th rendering the process of digestion more difficult.

Turning from theory to practical experience, we refer to the higher value- in an actuary's sense of the word—of Jewish lives than of those of their Genti neighbors inhabiting the same locality and engaged in avocations little differen Is not this recognized superiority on the part of the Jew due, in part at least, t their hereditary avoidance of blood during the course of three thousand years?

It is generally admitted that the internal organs of animals—such as the kid neys, the liver, etc.—are of questionable value as articles of food. They are, a we learn from carcase-butchers, very frequently in a diseased state, and are ap to be the seat of entozoa. We have not succeeded in ascertaining whether thes parts are avoided by the Jews at the present day. But the law seems perfectl clear (Leviticus, iii., 15, *et passim*) that in all cases of beasts sacrificed the "in wards" must be destroyed by fire.

The disposal of blood did not escape the attention of the Israelitish law-giver Directions are given that it is not to be let stagnate on the surface of the groun and there putrefy, but to be "covered with dust" (Leviticus, xvii., 13), or, in other words. absorbed in dry earth. Hence it seems fair to conclude that mor than three thousand years ago the peculiarly offensive character of putrescen blood and the deodorizing and disinfecting property of earth were known. Cov ering with earth is also the treatment specified for excrementitious matter. To the present day nothing is more offensively striking, wherever large numbers o human beings are collected away from their settled habitations, than the accumu lation of filth which defiles the neighborhood. Not merely sieges and other mili tary operations, but engineering undertakings, fairs, camp-meetings, pilgrimages, ar characterized by nuisances of this nature, which doubtless assist in the propaga

tion of typhoid fever, cholera, dysentery, etc., if the germs of these diseases are introduced. But Moses (Deut., xxiii., 12) gives special direction that excrement shall be dug into the earth. Indirectly this may be regarded as a prohibition against casting filth into the streams and water-courses. This view will appear strengthened by the decree that the falling of dead animals into small bodies of water (Leviticus, xi., 36) caused them to be regarded as unclean.

But whilst the use of blood as food is decidedly prohibited, and whilst its absorption in earth is enjoined, it figures in another capacity which has also a sanitary phase. It has been suggested to us that the application of blood to the doorways of the houses of the Israelites (Exodus, xii., 22 and 23) was not merely a symbolical act, but a prophylactic measure. The destruction recorded as coming upon the Egyptians was probably some zymotic disease, the proximate cause of which would be morbific bacteria in the air. It is represented to us as not improbable that these bacteria, or other microbia, would be attracted and absorbed by the fresh blood sprinkled on the door posts. This view of the case is fortified by the enactment that the Israelites were not to leave their houses in the morning. We are very far from presenting this supposition as demonstrated. But we understand that slaughtermen—who are, so to speak, constantly surrounded with *fresh* (in contradistinction to putrid) blood—are singularly free from epidemics. We have also witnessed experiments, which if not conclusive are at least suggestive. Organic solutions and infusions were placed in U-tubes through which air was drawn by means of a Sprengel pump. Before flowing into one of these tubes the air had to pass over a number of fragments of pumice slightly soaked in blood, whilst in the other cases it was passed over pumice similarly soaked in gum-water, solution of sugar, and other adhesive liquids. In almost every case the organic solutions which had received their air over blood were much slower in showing signs of putrefaction than were the others. Our friend contends that fresh blood has a positive attraction for morbific germs independent of its glutinous character. Experimentation during some outbreak of pestilence is here wanting, and in the meantime we suspend judgment.

We next come to the distinction between clean and unclean beasts as affecting the choice of food. We find excluded all carnivorous animals (Leviticus, xi., 27), the rodents (*Ibid.*, 5, 6, and 29), the carnivorous and carrion-eating birds (*Ibid.*, 13 to 19), reptiles (*Ibid.*, 30), amphibia, and mollusca (12). The question now arises whether these regulations are exclusively symbolical, or whether they have not at the same time a sanitary meaning. If we consider what animals are thus excluded, we can scarcely avoid entertaining the latter view. We find on the prohibited list, in addition to the swine—that eminently unclean beast—the mouse, and, a *fortiori*, the rat, and, as included among the carnivora, the cat and the dog. Here, then, we have in a group those beasts which are the home of *Trichinæ*, and through whose means, directly or indirectly, these parasites are introduced into the system. Is this a mere unintentional coincidence, or have we not rather a wise intention? It may be said that, save the swine, none of the animals thus mentioned are used for human food. Such an assertion would be a

great mistake. Dogs are eaten in China, in Poland, and from time to time, much nearer home, in the form of sausages. Cats enter into the Portuguese, and we suspect the Italian, *cuisine*. Rats and mice are eaten, not merely by Chinese and Gipsies, but find their way occasionally into soups, stews, and the like in Europe. Indeed, in "this our highly favored country," a certain person, probably influential and evidently ignorant, wrote to a daily paper recommending rats as food for the poor, and adding the humane suggestion that any man who complained of starvation whilst rats were plentiful should be punished! We will charitably hope that the writer was not aware that rats are foci of trichinæ, and are with good reason suspected of being one of the sources from which these pests find their way into cats, swine, and certain fishes, such as the pike. The domestic cat and all the feline group are frequently and seriously infested with internal parasites.

The prohibition of mollusca,—or, as they are familiarly called, shell-fish, and as we should interpret the passages in question, of crustaceans, such as the crab, lobster, and shrimp—may perhaps be considered needless. But not a few shell-fish, such as the common muscle and even the oyster, are at times capriciously unwholesome and even poisonous. The crustacea are not merely notoriously foul feeders—the shrimp being sometimes spoken of as the "scavenger of the ocean"—but their flesh is decidedly hard to digest. The snail is specially prohibited by name. Certain species of this animal are eaten in modern Europe and rank as a delicacy. But as they devour herbs poisonous to man, and feed greedily upon carrion and human excrement, their use as food is something more than questionable. It has been contended in reply that an animal which nourishes itself on poisonous or loathsome matter is not necessarily on that account poisonous or loathsome. There is some force in this remark in the case of a large animal, where the stomach and intestinal canal, with their undigested or half-digested contents, can easily be removed before the body is eaten. But in such small creatures as snails and shrimps such an operation could not be performed without a degree of anatomical skill and an outlay of time not to be expected from the ordinary run of cooks. Besides, it is too much to assume that an animal feeding on foul, morbid, and unwholesome matter may be in itself wholesome. The flavor and the odor of animal food, meat, milk, butter, etc., are most perceptibly affected by the diet of the beast from which they are obtained, and there is hence a strong probability that the flesh of a poison or carrion-feeder will be more or less unwholesome.

The hare is included among the prohibited species. Unlike many of its fellow rodents, it is not carnivorous, but it eats many vegetable poisons, such as the bark of the mezereon. It would be very interesting to ascertain in what animals, after death, the volatile organic poisons now known as ptomaines are most readily developed. It is possible that in this respect a difference might be found in favor of the "clean" beasts and birds of the Mosaic law.

As far, therefore, as food is concerned, we see in some instances very sufficient physiological reasons for certain of the prohibitions, and we have grounds

for suspecting at least that in other cases these regulations may be equally well founded. Certain it is that the Jews, by the avoidance of blood, of the flesh of unclean beasts, etc., have reached a standard of health higher than that of the Gentile nations among whom they sojourn. Shall we therefore justly incur ridicule if we pronounce these enactments wise?

From food we proceed to the surrounding of human habitations. Not only in the East under its modern rulers, whether Islamite or Christian, not only in mediæval Europe, but down to a comparatively late date, the streets of cities and villages were the common receptacle of filth and refuse of all kinds, stray dogs being the only scavengers. Dead domestic animals, excrements, spoiled food, bones, the rinds of vegetable, and every other noisome and unseemly by-product of human existence and activity, were allowed to accumulate in every corner. But why speak of streets? The interior of our houses, and even palaces and churches, three hundred years ago, must have been perfectly loathsome to any one —could such have been present—accustomed to cleanliness. How strange it is, then, to go back for more than three thousand years, and find in the laws of Moses directions that all unclean matter shall be cast into a waste place outside the city! The removal of nuisances was further made imperative by the command that if any person touched carrion or excrement, he shall be "unclean till the even." We can easily see that no Jew would be willing to tolerate any preventible nuisance in or near his dwelling.

We have, lastly, regulations on the subject of personal cleanliness. It is a sad fact that not merely mediæval but modern Europe contrasts most sadly in this respect with the principal nations of antiquity. One of the most striking features in the law of Moses is the number and variety of circumstances under which washing is required. Again and again we read—"He shall bathe his flesh in water." It may safely be said that in the ancient Israelitish community few persons would be able to pass a week without an entire washing. It may as safely be said that till very lately numbers of persons in modern Europe passed entire years without washing any part, save the hands and a circuit of six inches radius from the tip of the nose. So peculiar is human progress that it has taken three thousand years to bring the civilized world to a point less advanced than that occupied by Moses. Less advanced we say emphatically, because if we now admit the value of personal cleanliness, the importance of avoiding putrescent and loathsome matters, and of expelling them rapidly from our cities, and if we are theoretically aware of the disinfecting and deodorizing power of earth, we are far from embodying this our knowledge in the practice of actual life. As to the avoidance of blood, of the flesh of foul-feeding animals, and of such as are liable to introduce entozoa into our systems, we do not even recognize verbally the importance of the Mosaic teachings. We eat "blood puddings," we feed swine with blood and with semi-putrid offal, and then we eat the animals which have been gorged on this revolting diet. And we pay the price of this uncleanliness in shortened

lives and in waning vigor. We again call attention to the remarkable physiological insight displayed in the sanitary code of the ancient Israelites, and we repeat the question, Whence did it spring?—*London Journal of Science.*

BRAIN-GROWTH AND CIVILIZATION.

In a progressive civilization, such as prevails in this country and throughout the greater part of Europe and America, there is reason to believe that the cranial capacity of the population is, on the whole, increasing rather than diminishing. Owing to the want of early observation, it is difficult to institute comparisons between past and present. An opportunity, however, lately occurred in Paris, which was taken advantage of by M. Broca. In digging the foundation of a new building, a vault was opened containing a large number of skeletons, whose surroundings proved them to have lived not later than the twelfth century. M. Broca found the average capacity of 115 of those twelfth century skulls to be 1,426 cubic centimetres; while another series of skulls—125 in number—taken from a cemetery belonging to the early years of the present century, gave an average of 36 cubic centimetres more. The average Parisian skull would thus seem to have increased considerably in capacity during seven centuries of progressive civilization. That this increase has gone on slowly but surely as man progressed from barbarism to civilization may be inferred from a study of the cranial capacities of the various human races. Thus, while the brain capacity of the European amounts to 94 cubic inches, it is only 91 in the Esquimau, 85 in the Negro, 82 in the Australian, and 77 in the Bushman. These are merely averages, and, as such, do not bring out the important fact lately noticed by Le Bon, that among the lower races the limits of variation in the cranial capacity of individuals of the same sex are much less extended than in the higher races. Thus, among modern Parisians large and small skulls vary by about 600 cubic centimetres, while negro skulls vary only by 204, and ancient Egyptian by 353 cubic centimetres.

Another important difference in the cranial capacity of the higher and lower races is connected with sex, and serves to throw light upon the influence of mental exercise in increasing brain capacity. According to Prof. Bischoff, of Munich, in a recently published work, the difference between the average brain-weight of men and women is 10½ per cent. Much of this is undoubtedly due to difference in stature, a tall person having, *cæteris paribus*, a larger brain than one less in height; partly, however, it is attributable, there can be little doubt, to inferior mental training. Among the lower races, where the women have not only charge of the offspring, but have also to share, and that largely, in the husband's occupations, the brain capacity of the two sexes show, much less difference. The difference, according to Le Bon, between the average capacity of the skulls of male and female Parisians is almost double that found to obtain between the skulls of the male and female inhabitants of ancient Egypt. Civilization, by giving increased exercise, especially to the male brain, has, there is good reason to believe,

gradually produced that increase of brain capacity which now distinguishes the civilized from the savage races of mankind. Nowhere has this influence been more conspicuous than in China, whose culture, if not of the most advanced kind, has the advantage over all others in the great length of time it has endured. The Chinese are, as might have been expected, a big-brained people; indeed, the only statistics of Chinese brain-weights available show them to exceed all other nations in this respect. A few years ago the brain-weights of eleven adult male and of five female Chinese—the chance victims of a great typhoon at Hong Kong—were obtained. These belong, with one exception, to the Coolie, or lowest grade of Chinese society, and yet the average brain-weight of the males reached 50½ ounces, and that of the females 45½ ounces. This is an average not attained, so far as yet known, by any other nation, it being fully two ounces above that of the average negro, one and a half ounces above the European, and one-half ounce above the average Scotchman. That civilization has been the main cause of increase in the size of the brain there can be little doubt. To admit, therefore, that the heads of the British people are now growing smaller, would be to confess that the resources of civilization were indeed exhausted, and that, as a people, we had begun a retrograde journey toward the barbarism from which we originally emerged.—*Edinburgh Scotsman.*

THE MORALITY OF THE OPIUM TRADE.

Having afforded space on several occasions to papers expressing the views of the majority on the question of the habitual use of opium, it may be of interest to place on record the statements of the minority. Dr. George Birdwood, late Professor of Materia Medica, a curator of the Government Economic Museum, writes in the *Times*, of London, as follows:

In view of the undiscriminating agitation which is being manufactured all over the country against the Indian opium revenue (amounting to from £7,000,000 to £9,000,000 sterling a year), on the ground of its imputed immorality, I beg the favor of being allowed to place on record the opinion which I have been led, by years of intimate study and observations in Bombay, to form of the effects of the habitual use of opium on the people of the East. I do not propose to enter into the economical questions of the Indian opium revenue or into the political question of our alleged forcing the importation of the drug on the Chinese. I shall confine myself as much as possible to my personal experience of the general effects of *smoking*, *eating*, and *drinking opium* on the Chinese, Mussulmans and Hindoos of West India.

As regards *opium smoking*, I can, from experience, testify that it is of itself absolutely harmless. I should like those who have been led to believe, on the unscientific observations of others, that it is harmful, to simply try it experimentally for themselves, under proper precautions, of course, against the risk of using the imperfectly prepared *chandu* or "smokable extract" of opium. I feel satis-

fied that the more thoroughly they test it, the more strongly will they be convinced with me that the smoking of opium is of itself a perfectly innocuous indulgence. I have known cases of desperate suffering, resulting apparently from excess in opium smoking, such as unscientific observers hold up, *in terrorem*, before the British public. But these cases were always of moral imbeciles who were addicted to other forms of depravity, and the opium pipe was merely the last straw laid on their inherently enervated and overstrained backs. Opium has been smoked for generations in China, even within the precincts of the Imperial Palace, at Pekin. As far back as 1769, edicts were issued against the practice, but in vain, so deeply were the people already devoted to it at that date. The determined, obstinate instinct of the Chinese people in its favor, paralyzed even the despotic endeavors of the Chinese Government to suppress it; and long before we became entangled in the quarrel between the Chinese and their Government on the subject, the Financial Board at Pekin had advised recognition of the national habit by the imposition of a tax on opium, on the ground that the increased rigor of the laws enforced against its use since the beginning of the century had only tended to increase the bribes offered to officials for their connivance in it. This judicious proposal was rejected by the Chinese Government with a great flourish of moral indignation, and the crusade against opium smoking continued with renewed severity. All the same, the popular custom proved irresistible, and its victory in the end was of incalculable benefit to the Chinese, as it served gradually, wherever opium smoking prevailed, to completely entice them away from the use of their native ardent spirits.

This historical fact should never be overlooked by those who have been led by their blind philanthropy to believe that opium smoking is necessarily injurious to the Chinese, and that, therefore, the Indian opium revenue is immoral. No one will deny, that, at all events in tropical countries, the effects of excess in ardent spirits are worse than those of opium, and it would be unfortunate, indeed, if, as a consequence of the abolition of the Government manufacture of opium in India, the Chinese were led back to the use of the ardent spirits of their own baneful distillation. It would be the undoing of probably the greatest temperance triumph of any age or country; for I repeat, that, of itself, opium smoking is almost as harmless an indulgence as twiddling the thumbs and other silly-looking methods for concentrating the jaded mind in momemtary *nirvana*. The mind often seeks a lullquiescence without vacuity, and finds it in any of the strangely infectious ways—opium smoking among the rest. But, it may be asked, What of the opinion of the Chinese Government as to the morality of opium smoking? It is, I believe, partly due, as with other worthy people, to their not distinguishing between the accidental concomitant of a debauched life and the antecedent inducements to it, but chiefly to the fact of official Chinese ideas of morality being founded on an artificial religious system, and not on the national habits of the masses of Chinamen. The scholastic official ideas of morality in China are utterly at variance, as is obvious in regard to opium smoking, at least, with the universal practice of the people. Be that as it may, all I insist

XUM

on is the downright innocency, in itself, of opium smoking; and that, therefore, so far as we are concerned in its morality, whether judged by a standard based on a deduction from preconceived religious ideas or an induction from national practices, we are as free to introduce opium into China and to raise a revenue from it in India as to export our cotton, iron, and woollen manufactures to France. The habitual eating and drinking of opium are altogether different things from smoking it as a gentle incentive to restorative repose of mind. *Opium taken internally is a powerful and dangerous narcotic stimulant*, but even so it is no worse in the effects produced by excessive use than alcohol. It is, and has been, immemorially used throughout vast regions of the East. It satisfies a natural human craving for some paregoric stuff or other, "banishing sorrow, wrath-allaying, and causing oblivion of all cares;" while its consumption has been further fostered by the religious ban imposed in Asiatic countries on the use of alcoholic spirits. Alcohol acts with doubly destructive force in tropical climates and with awful rapidity, and its victims are a constant danger to others; whereas, the sufferers from the abuse of opium are seldom dangerous to others, and are a nuisance only from lingering so long in a state of harmless dullness on the hands of their relations. Nothing, moreover, is so offensive to respectable Asiatics as the violent excitement caused by wine and ardent spirits; and opium enables these dignified persons, who dare not break the ecclesiastical law against alcoholic drinks, nor outrage the social feeling against noisy intoxication, to safely satiate their natural craving for something at once stimulating and soothing. The ill-effects of the habitual use of opium in excess are developed almost exclusively among those who, by some weakness or injury of brain, or by the unhappy circumstances of their lives, are predisposed to over-indulgence. The habit of destructive excess among them is, in fact, usually to be traced to chronic diarrhœa, chronic cough, chronic fever, and the long religious fasts, alike of Buddhists, Hindoos, and Mussulmans, in which opium is used to allay the pangs of protracted hunger. Besides these unfortunates, the weak-brained, the dissipated rich, and the hopelessly poverty-stricken, are the only sufferers. Sound, hale people, in comfortable circumstances, who lead healthy lives, seldom or never suffer from the habitual use of opium, even in quantities that seem to be excessive.

There are few finer people in the world than those of Goojerat, Kattyawar, Cutch, and Central India, and they are all addicted to the habitual use of opium. In Rajpootana, high and low, rich and poor, indulge in it to the most alarming excess, measured by the quantity they take, but, as regards the mass of population, with impunity. These Rajpoots are splendid men, well-formed, handsome, and of the most chivalrous and romantic temperament. Their custom is to drink the opium in the form of an emulsion called *Kasumba*. It is prepared and served in a bow like an enormous pap-bowl, from which it is poured into the joined palms of every visitor to drink of it, and the Rajpoots are always taking the paregoric draughts from morning till night. But they are robust and active, constantly in the open air, and, as a rule, suffer no more from their immoderate potations of *Kasumba* than healthy country-folk in England from sound ale, or Tartars from

Koumiss; certainly not so much as "Glasgow bodies" from whisky, or Londoners from gin. The women in Rajpootana prepare the *Kasumba*, and it will be remembered that in the Odyssey it is Helen who prepares the famous nepenthic drug.

"Meanwhile, with genial joy to warm the soul,
Bright Helen mixed a mirth-inspiring bowl."

In 1809, Rajpootana was thrown into disorder by the contest of the princes for the hand of Krishna Kumari, the beautiful daughter of the Rana of Oodeypore. To stay the fratricidal strife, the heroic maiden mixed a bowl of kasumba, and exclaiming: "This is the marriage foredoomed for me," drank it off at a draught and sank down and died, so restoring peace to the distracted land. I have a strong suspicion that the free use of opium in Rajpootana acts as a preventative of malarious fevers. It is evident, in short, that there are two sides to the question of the morality of the use of even opium itself, and all the facts regarding its real effects should be fully placed in evidence before the public when the relations of the Government of India with its manufacture and exportation are being made the butt of ignorant and prejudiced opposition. Even the eating and drinking of opium appeared to me so little harmful, and the instances of any consequent evil so rare, that all the time I was in India I was an advocate of the use of all stimulants in moderation, and it was only when I returned to England, and saw on all sides of me, and every day, the evil effects of the abuse of alcohol, that I was gradually led to sympathize with those who urge voluntary abstinence from every form of stimulant. If, however, it is impossible to object altogether to stimulants, we can no more object altogether to opium. Its use is merely a question of geography and race, and not of morality in the least. *A fortiori*, there is nothing to be said on moral grounds against opium *smoking*. If any one will test its effects, he will find that half its soothing and pleasure is derived from the opportunity it affords for abandoning one's self for a few moments to idleness with the pretence of occupation, in preparing the dainty apparatus used by well-to-do connoisseurs in the operation—the elegant lamp, the exquisite damascened pipe, and quaintly chased silver pins, and cleaning and putting them all back again in the drawer of the low japanned table, which is the respectable opium-smoker's fire-altar and altar of incense in one, from which the smoke goeth up continually. Those who are fond of rolling up their own cigarettes—probably not composed of tobacco—will understand this. Then for the rest, there is the supreme satisfaction felt by men of every color, creed, and race, in passing any mild smoke, especially if it be in any sort fragrant, in and out of the mucous passages of their head, which pleasure is quite independent of the positive physiological action that the smoke-stuff itself may possess, while for any narcotic property there may be in the smoke of thoroughly combusted *chandus*—in the ashes, that is, of smokable extract of opium—the subtlest chemical analysis would probably be baffled to find it out. Blowing soap-bubbles itself can, indeed, scarcely be a more ethereal enjoyment than sucking *chandu* smoke into the throat and blowing it out again through the nose, and sometimes, by finished performers, through the inner corners of the eyes.—*New Remedies*.

THE EXACTNESS OF THE SCIENCE OF MEDICINE.

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The frequent allusion to medical men as having pursued their studies in search of positive knowledge in vain, and the often repeated public and private declaration that there is nothing of *exactness* in the diagnosis and treatment of disease, together with the consent of many medical gentlemen themselves, that the laity should hold them as "agnostics" except in a few simple matters about which the opinions of non professionals are of equal value, prompt the writer to make a few observations which may tend to place the physician in a more correct light with those who may need his advice. Let us premise by the statement of an everywhere observed fact, that those who know the least about a given subject are often loudest in disapproval of and disagreement with the opinions of previous investigators. And it is to them evidence of merit to be able to brand the opinions and researches of their fathers as "leading nowhere" and as possessing no accuracy.

It cannot be expected that any one not having given special study to our profession will be able to give expression to very correct opinions of the various departments taught by it, and it should be still more unlooked-for that one who has spent a large part of his life in its practice, should have made so little progress in the direction of its mastery as to be betrayed into the declaration that there is little or nothing in medical appliances worthy of the confidence of those in need of a physician. The custom of selecting an orator, on the occasion of the public graduation of a class of medical students, from the ranks of the legal or clerical fraternity, is, no doubt, in bad taste, for these gentlemen are prone to have "opinions of their own" about matters to which they have given but little thought.

I protest against a general misrepresentation of a class of men whose studies and labors have ripened into accurately formulated arts and sciences which know no rival among the learned professions. If it is true, that, after more than two thousand years of toil and unceasing research, we have reached no resting place, and that our visits to the sick are nothing more than artful deceptions by which we obtain our "bread and butter," let us in honor to ourselves and duty to our race, abandon our calling. But there is a brighter and truer side to this question, which I propose to spread before the reader; a short outline of the present status of medical knowledge; not by the long and tedious line of investigation by which the facts have been reached, but by a simple display of the facts as they now relate to the sciences and arts of our profession. What may have been written or said, along the weary years of experimentation, by those who truly felt that they had reached the bottom of but few subjects of inquiry, can have no bearing against the position of this article, as touching the vast amount of well-digested and accurately formulated material made ready for our use.

At this point we affirm that any department of knowledge whose facts and principles admit of classification and are subjects of proof may be properly termed an *exact science.* By a little reflection it will be seen that all this is eminently true of medicine. Its classification may be correctly stated as follows:

1. That department of our profession relating to the present status of knowledge bearing on the possibility of a sufficiently accurate determination of pathological conditions and the application of remedies that will bring the desired cure. This is the stand point of our subject from which come so many evils to the people and much disrepute to our calling. The land is burdened with numberless men and women who possess all the needed *legal* rights to prey upon the credulous public with a pretense of knowledge they do not possess. A show of professional deportment and a display of office equipments often do much to obliterate the vast distance between the soulless quack and the hard working student. And it may be a long time before the people will be able to make a wise selection from those who offer their services as medical experts. And yet it is a truth beyond a doubt that the aggregate of medical knowledge, now well formulated and within the grasp of every faithful student, is worthy of our highest confidence. I confidently affirm that the want of exactness exists in the brain of him who asserts it, and I also believe that the educated physician may undertake the task of pointing out the exact disease and its exact remedy with the assurance of one standing upon a rock. The well determined rules of diagnosis never fail him. His well-selected remedies do their work with a promptness and accuracy near to perfection. The fact that much that was supposed to be settled beyond a doubt, in the ages past, has been abandoned as weak and perhaps harmful, is just what we might anticipate under the light of improved facilities and innumerable investigations. The wholesome laws of most of the States, together with the wish of the friends of the dead put within our reach ample means to obtain every variety of *post mortem* knowledge.

2. The second classification of our subject brings us to surgery. No one learned in its present literature will hesitate for a moment in according to this branch the well-earned eminence of being both a science and an art. I grant a good degree of reputation may be reached here and yet the surgeon may not possess all the high traits of judgment needed in some other department of our calling. He always has the advantage of an over-estimate on the part of the laity. He gets the credit of possessing that wonderful something supposed to culminate in but few mortals, making him a surgeon when he may in fact deserve but the credit of a skillful mechanic. The anatomy of every part of the human body is so thoroughly a matter of memory that any desired operation can be performed by any one possessing good mechanical talent. But these primary facts do not constitute the whole of surgery. That which makes a surgeon useful in the presence of injuries, deformities, and pathological conditions, is his ability to recognize the trouble needing his aid. And it is a pleasure to be able to assert that he is not left to blindly guess his way in the direction of his movements. The locality of pain or swelling, the presence or absence of the characteristic phlegmasia, the

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character of the pulse and the general condition of the patient furnish the data for differential diagnosis so that the knife need never enter human flesh on an uncertain errand. That professed surgeon, who, in a recent search for what he had pronounced an ovarian tumor, found an advanced pregnancy, was very properly prosecuted for malpractice and driven to some service better suited to his want of culture. There is absolutely no excuse for such manifest blunders. The present century is all ablaze with the surgical exploits of the many who adorn its fair history with what they have done for those suffering with surgical diseases. The exact rules which they have formulated for the guidance of all who would be masters of the art are so fully set forth in all the recent publications that none need be without their aid. The names of Gross, Billroth, Da Costa, Pancoast, Frank Hamilton, J. Marion Sims, and a host of others, and last but by no means least, the honored name of our own Joseph Wood, M. D., (who more than a quarter of a century ago invented and promulgated an unerring procedure for the removal of stone in the bladder,) are all living witnesses to the accuracy of what is known on this subject.

3. The third classification relates to materia medica, or that which has to do with the discovery and utilization of agents used in the treatment of disease. Here we draw upon all of nature's resources for the selection of remedies. And the law of the "survival of the fittest" has been fully illustrated under the unerring dominion of the laws of chemistry. The old empirical experimentation has given place to a certain and accurately classified pharmacopœia, so that he who makes fatal blunders must charge it to his own inexperience or stupidity rather than to want of exactness in the preparation of his remedies. It is wonderful what assistance has been rendered to the physician by expert manufacturing chemists, in the repose and confidence he feels in administering their carefully prepared medicines. Dr. Squibb and the able chemists at the head of the establishments of Wyeth Brothers, Powers & Weightman, Tilden & Co., and many others, whose remedies are found in every city of our land, have done excellent service in this direction. The knowledge which we possess in this department puts at rest all anxiety so long felt by the medical fraternity touching how and what to do in the treatment of disease. The list of the agents known to possess special and clearly marked characteristics in their action is large and quite complete. There is no guess-work in their anticipated effects. The various preparations of opium, and and cinchona bark, the known and well-marked effects of the various forms of iron, mercury and iodine, put to the blush any person who doubts the certainty of remedial agents. So perfect have been our researches in the domain of medicines that you may bring to my office the most utterly unknown sample of mineral or vegetable, and I can, with the aid of those skilled in the art of chemistry, give it such perfect analysis as to enable me to prescribe it, the first time in its history, with as certain a knowledge of its effects and trust in its curative agency with the same confidence I may have in the oldest remedy within my knowledge. The practitioner who is always adding to his list, is no longer

branded as an unsafe empiric, for the reason that he knows that an unerring science has been at work in the preparation of his prescriptions.

4. The fourth division is that department under which we classify the facts governing pregnancy and the succeeding periods of gestation up to the point of birth. Then follow the successive steps in the mechanically accurate laws of delivery. There is no science or department of knowledge subject to a clearer classification of its laws than the one now under consideration. The testimony of medical experts in our courts of law as to the existence of pregnancy at a certain period, and of non-pregnancy at another period, is taken as conclusive in establishing titles to estates, or fixing the guilt or innocence of persons against whom charges of moral or civil misdemeanors are preferred. Society itself, in its varied estimates as to the fitness of persons claiming recognition, bases its judgments largely on its belief in the accuracy of the statements of their medical adviser touching the period of the advent of the first-born of any family circle. So correctly does nature advertise the exact stage in her periods of development, that the most cunningly devised costume cannot conceal the prophecy of forthcoming events from one accustomed to observe "signs and seasons." Barring the fact that there are exceptions to all rules, we may assert confidently that he who has carefully observed and recorded the history of a single case of normal gestation may be sufficiently sure of his knowledge to govern his conduct in every case according to his observations in the first case. Having thus assured himself of his knowledge of the case prior to birth, he may approach the couch of his parturient patient with the steady confidence of a master in the art of assisting nature. Never was there constructed a piece of machinery that performed its work under a more perfect obedience to the laws of mechanics, or compassed its periods of revolution at the behest of a more certain time-table, than does nature accomplish her flexion, descent, rotation, restoration and expulsion in her masterly work of delivery.

These facts have so long passed under the eyes of diligent observers that they stand to the cultured physician as the unerring finger-board pointing him in the direction of certain exact results from which he can offer perfect assurance to anxious friends. And he who fails to master such a case and carry it to a safe conclusion need not hope to cover his ignorance by asserting that there is nothing exact in this department of our profession. Thinking people will soon discovery his utter unworthiness to be trusted with the high and holy responsibilities of his calling.

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METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during month 29.44, on the 7th. Lowest barometer during month 28.40, on the 27th.

Highest temperature during month 77°, on the 18th. Lowest temperature during month 6°, on the 21st.

Highest velocity of wind during month 52, on the 20th. Total travel, 11,221 miles.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Feb. 20th to Mar. 1st.	Mar. 1st to 10th.	Mar. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min.	25.0	25.7	30.4	27.0
Max	42.0	53.9	55.4	50.4
Min. and Max	33.5	39.8	43.0	38.8
Range	17.0	28.2	25.0	23.4
TRI-DAILY OBSERVATIONS.				
7 a. m.	33.0	34.1	34.0	33.7
2 p. m.	45.0	46.2	53.0	48.1
9 p. m.	35.0	37.5	43.9	38.8
Mean	39.0	39.0	43.7	40.6
RELATIVE HUMIDITY.				
7. a. m.	.78	.63	.80	.736
2 p. m.	.75	.50	.56	.60
9 p. m.	.78	.65	.74	.72
Mean	.77	.59	.70	.69
PRESSURE AS OBSERVED.				
7 a. m.	28.93	28.99	28.88	28.93
2 p. m.	28 92	29.00	28.85	28.92
9 p. m.	28.93	29.05	28 89	28.96
Mean	28.93	29.01	28.87	28.94
MILES PER HOUR OF WIND.				
7 a. m.	10.7	19.7	14.9	15.1
2 p. m.	18.0	20.1	23.4	20.5
9 p. m.	10.1	16.3	15.4	13.9
Total miles	2685	4384	4152	11221
CLOUDING BY TENTHS.				
7 a. m.	5.2	5.9	6.1	5.7
2 p. m.	5.6	6.7	5.9	6.1
9 p. m.	4.4	4.1	4.1	4.2
RAIN.				
Inches	.50	1.07	.12	1.69

BOOK NOTICES.

HISTORY OF ANCIENT EGYPT. By George Rawlinson, M. A.; two volumes: 8vo., pp. 1143. Boston: S. E. Cassino. Estes & Lauriat, 1882. For sale by M. H. Dickinson, $6.00.

Until very recently no account of Ancient Egypt, combining its antiquities with its history and embracing its manners, customs, art, science, literature and religion, had been published. Since 1876, however, three have appeared, of which that now under consideration is the most complete.

These volumes are magnificently presented by the publishers; the paper, type, and illustrations being of the finest quality, and fully equal to the English edition, though costing less than one-third as much. Professor Rawlinson's previous historical works had prepared his readers for a comprehensive and valuable work, which expectation is fully met. Commencing with its geography, he takes up consecutively the climate and productions of ancient Egypt, the people and their neighbors, their language and writing, literature, agriculture, architecture, mimetic art, science, religion, manners and customs. The whole of the first volume is devoted to these preliminary accounts; the second to a chronological record of the progress of this wonderful people from the earliest times, when all is dim and uncertain, through the various dynasties, to their conquest by Cambyses, about five hundred years before Christ, when the death of Psamatik terminated the long line of the Pharaohs which had ruled Egypt for not less than twenty centuries.

The greatest difficulty in the way of writing a reliable history of ancient Egypt consists in the impossibility obtaining its correct chronology. The best and most faithful students of this subject differ to the extent of over three thousand years regarding the date of the accession of the first king to the throne. Fortunately, this uncertainty does not exist in other historical matters and, as the Egyptian people maintained a separate and independent existence during its entire career, the need of chronological exactness is not so absolutely important as it would be otherwise. This extreme isolation doubtless preserved the national immobility and homogeneity during its almost fabulously long continuance, for it appears that as soon as other nations and peoples began to make an impression upon it, by introducing a more modern and progressive civilization, it succumbed and in an incredibly short time its nationality was lost and its grandeur mere heaps of ruins.

No more interesting work than this has been written in recent times, whether we regard the strictly historical portions or the discussions of art, science and literature which grow out of them and show the author's familiarity with such subjects. In the presentation of the religious beliefs and practices of the people,

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an interpretation also of those of their contemporaries, the Jews, is frequently given, which is extremely valuable and interesting. In fact, every portion of this work is full of attraction to readers of every class, and it is certain to meet with a large sale.

FIRST ANNUAL REPORT OF THE BUREAU OF ETHNOLOGY, 1879–80. By J. W. Powell, Director; quarto, pp. 603; Washington,: Government Printing Office, 1881.

Major Powell, in making this report to the Secretary of the Smithsonian Institution, modestly gives the principal credit of his success to Professor Baird, but the reader will soon conclude that to his own earnest and untiring labors, at least as much is due. To his own hand are we indebted for a great portion of the work, viz: for the Introductory, a chapter on the Evolution of Language as exhibited with specialization of the grammatic processes, the differentiation of the parts of speech and the integration of the sentence; from a study of Indian languages; a sketch of the Mythology of the North American Indians, including the genesis of philosophy, the mythologic and scientific stages of philosophy; the four stages of mythologic philosophy; the outgrowth of mythologic philosophy, and the course of evolution in it, and mythic tales. Also Wyandot Government, a short study of tribal society, including the family, the gens, phratry and the tribe; also a chapter entitled Limitations to the Use of Anthropological data.

The remainder of this handsomely illustrated and printed volume comprises a further Contribution to the study of the mortuary customs of the North American Indians, by H. C. Yarrow; Studies in Central American Picture-writing, by E. S. Holden; Cessions of Land by Indian Tribes to the United States, by C. C. Royce; Sign-Language among North American Indians by Col. Garrick Mallery; Catalogue of Linguistic manuscripts in the Library of the Ethnological Bureau, by J. C. Pilling, and illustration of the method of recording Indian Languages, from the manuscript of Messrs. J. O. Dorsey, A. S. Gatschet and S. R. Riggs.

This work is an excellent contribution to Ethnology and ably supports the statement of Major Powell, that "Anthropology needs trained devotees with philosophic methods and keen observation to study every tribe and nation of the globe almost *de novo* and from materials thus gathered a science may be established."

THE GOSPEL IN THE STARS. By Joseph H. Seiss, D. D.; 12mo. pp. 452: E. Claxton & Co., Philadelphia, 1882. For sale by M. H. Dickinson, $1.50.

This work is offered by the author as the result of careful study of primeval astronomy and of the origin and meaning of stellar nomenclature, and in support of which he quotes and cites many distinguished astronomers and oriental scholars, such as Seyffarth, Riccioli, Josephus, Drummond and Mitchell.

Christianity was once explained by a class of speculative atheists to have originated in the astronomical myths handed down from remote ages, but Dr. Seiss takes the opposite position and undertakes to prove that the names of the constellations and their relations to each other are in reality clearly vestiges of the earliest revelations of God's plans for redeeming the world.

Taking up the signs of the Zodiac, beginning with Virgo, instead of Aries as is customary, he points out the origin of life, thence the son and seed of the woman; next Libra, or the balances, as symbolizing the eternal justice of God; then Scorpio, as typifying the serpent and the conflict between Christ and the Devil, and so on through all of the signs and their deccans or accompanying and accessory constellations.

Certain it is that the period of arranging and naming of the constellations antedates any positive knowledge that students have been able to obtain, though they have been traced back into Egyptian and Jewish history to the days of Abraham and beyond—say 3,000 years before Christ. Many new constellations have been framed and named in more modern times, but their titles merely serve to commemorate noted men and deeds of antiquity, and they are not taken into account by our author, who traces consecutively and systematically from the oldest ones the gospel history of the Saviour and of his church on earth.

The theory of the author is plausibly sustained by the facts given and texts of scripture quoted, and, whether we adopt it as fact or regard it merely as a work of fancy, it will repay careful examination and will excite intense interest in the mind of all readers.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA., PART III; August to December, 1881. Octavo, pp. 536. Philadelphia, 1882.

The editor and publication committee have, as usual, done their work well and here put forth a volume which, in matter and style, is highly creditable to the Academy. Among the contributors of results of original investigation we note Messrs. Chas. Wachsmuth and Frank Springer, Angelo Heilprin, J. H. Redfield, Rev. H. C. McCook, Dr. H. C. Wood, Thos. Meehan, Edward Potts and Dr. H. C. Chapman. Following these are the annual reports of the officers and of the various sections. It is interesting and remotely encouraging to our own Academy to note that the total receipts of money from all sources during the year 1881, amounted to $7,870.87, and that the Academy has nearly $20,000 invested in bonds and mortgages.

THE OYSTER INDUSTRY. By Ernest Ingersoll; quarto, pp. 250: Government Printing Office, Washington, 1881.

This is Monogram B, Section X, of the History and Present Condition of the Fishery Industries, prepared for the Tenth Census of the United States, un-

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der the direction of Professor S. F. Baird, U. S. Commissioner of Fish and Fisheries, and is an exhaustive descriptive and statistical illustrated report of the whole subject, beginning with the oyster industry of the maritime provinces of Canada and taking in the entire Atlantic coast, as well as those of the Gulf of Mexico and the Pacific Ocean; closing with the Natural History of the Oyster, a glossary of terms and general summary.

Professor Ingersoll has evidently devoted a great deal of time and careful investigation to the preparation of this report, and has certainly collected a vast and instructive array of facts on a subject of which most persons are utterly ignorant; for which he is entitled to great credit.

OTHER PUBLICATIONS RECEIVED.

A Recalculation of the Atomic Weights, by Prof. F. W. Clarke, S. B., University of Cincinnati; Proceedings of the Boston Society of Natural History, Vol. 21, Part II, December, 1880, to October, 1881; Financial Reform Almanac for 1882, London, Longmans, Green & Co.; The Palæolithic Implements of the Valley of the Delaware; Free Trade *vs.* Fair Trade, Cassell, Petter & Galpin & Co., 1882; Bulletin of the Essex Institute, Vol. 13, to December, 1881; Semi-Annual Report of the Comptroller of the City of Kansas, Mo., December 31, 1881.

SCIENTIFIC MISCELLANY.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

A late important invention for providing armor for war ships, and one in which the government of the United States is actively interested, has been designed by a retired invalid engineer of the Navy, Mr. N. B. Clark. The House Committee on Naval Affairs has already virtually decided that the new war vessels, to be built under the funds recently appropriated by Congress, shall be constructed after Mr. Clark's plans. This invention consists essentially of a submerged "turtle-back," or concavo convex shield or deck, arranged below the water-line of the ship, and extending from side to side and stem to stern, and which forms a deflecting invulnerable shield. A shot, from any direction, necessarily strikes this turtle-back at an angle, thereby deflecting the ball and protecting the vitals of the ship. Each gun of the ship is provided with a wedge-shaped deflecting shield, rounded at the back, so as to completely shield the gunner.

The magazine is stored below the turtle-back and the charges are supplied to each gun by separate pipes leading into the shield of each gun, and up through which, prepared ammunition is forced as required. This construction admits of only one man manipulating and firing the gun, including the great caliber centrally mounted guns which are operated by steam-power.

Great attention has been given of late, since Edison's widely published experiments with the electric light. A late and novel means for adjusting the carbons employs three electro-magnets which control the same. One electro-magnet in the main or arc-circuit, and a second in a derived or shunt-circuit of high resistance about the lamp act upon the opposite ends of a common armature-lever to establish the arc and operate the clutch mechanism respectively, while the third is normally shunted out of the circuit by spring-contacts, which may be broken when too great a current passes through the shunt-magnet around the lamp. This third magnet is connected with devices for feeding or forcing the upper carbon forward positively when the clutch mechanism accidentally holds it.

A novel pulley-band, for driving machinery consists of an elastic cord surrounded with metallic rings or spirals. The spiral wire serves, it is said, to protect the elastic cord from abrasion or wear, which would otherwise be very great in cords of this description.

A new safety device for telegraphic wires for preventing injury due to the overcharging of the line, consists of two upright flat springs electrically connected in the circuit. Their upper ends rest normally in a notched end of a centrally pivoted armature of an electro-magnet. A retractile spring operating against the armature keeps its notched end over and in contact with the upright springs so that the ordinary current used in working the line will not prevail over said retractile spring. A dangerously strong current, however, causes the magnet to overcome the resistance of the retractile spring and draw one end of the armature down so as to free said springs from the other end and thereby breaks the current.

A new steam-engine, in its construction, proceeds upon the novel principle of saving the latent heat in the steam operating a steam-engine, that is, to operate the same to a high degree of expansion—say four times—and to form the space or clearance in the ends of the cylinder, or its passages, of sufficient capacity to contain the steam after compression by the reverse movement of the piston after the expansion of such steam. No exhaustion of the steam is permitted after each stroke, but the condensed steam or water is withdrawn by a pump and forced into the boiler. The loss of steam, so condensed at each stroke, is supplied by live steam from the generator. The operation of this engine is based upon the fact that when steam is performing work in a steam-engine the heat contained therein is converted into power, causing a corresponding decrease of pressure of such steam. Consequently a less amount of power is regained to compress the steam to its original pressure after working expansively in a steam-cylinder than it exerted during the performance of such work. If a certain amount of steam is admitted to a steam-engine cylinder, from which neither heat nor steam can es-

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cape, and work is applied to the piston, causing a compression of steam into a smaller volume, thereby increasing its pressure, such work is stored up and available, as it would be if used in bending a steel spring.

A novel telephone-transmitter has a button of the following description attached to the vibrating diaphragm of the mouth-piece, and interposed in the circuit of an electric current: The button is composed of masses of conducting pellets or globules—as lead shot, or a fine grade of any such well-rounded particles—which, when pressed together in the form of a button, will not shift. Sound waves acting upon said button cause undulations in the electric current.

FIRE-PROOF BUILDINGS.

VALUABLE SUGGESTIONS BY GENERAL M. C. MEIGS.

The recent fire in New York has revived the old question of fire-proof buildings. The burning of the Morrell store-house on Thirty-second Street last fall was a surprise to many, as it was considered fire-proof. Taken in connection, however, with the recent burning and loss of life on Park Row, the public is beginning to realize that such a thing as a fire-proof building is not to be found. Iron buildings burn, crumble, and collapse with heat; stone offers but slight opposition to the progress of flames when the latter gets a fair headway. Indeed, nothing but solid brick and mortar seem to be able to resist the ravages of heat any length of time. Wood, when properly protected makes, all things considered, the best fire-resisting material, with the exception of brick, used for construction purposes. The writer has seen a door frame of two thicknesses of one inch oak screwed together, resist a hot fire, for a period of forty minutes, thereby saving valuable property and perhaps lives. An iron door would have warped and twisted to such an extent, that the flames would have lapped around and beyond it in five minutes. A timber post will sustain its load until the last, whereas an iron one will warp, double up and let the whole structure fall at the shortest possible notice. Three-fourths of the city buildings that take fire are not destroyed by fire; they simply get heated enough to warp and displace the supports, then the whole thing falls in and burns up.

Buildings constructed of wood, with walls and floors made solid by filling in with concrete, mortar, or other inflammable materials, burn so slowly that danger to life by burning in such cases could not occur without criminal negligence. Indeed, a structure of wood, built as suggested, would rank amongst the best of fire-proof buildings, and more particularly would this be the case if all the timber-work was protected by plaster covering, and resinous woods and oil paints avoided. General Meigs, of the War Department, Washington, in an excellent letter to the *New York Herald*, a few days ago, on the subject of the late fire, makes use of the following language:

"Iron is not fire-proof. It is, in fact, a combustible, and with heat enough not only bends and yields, but actually burns up. It resists a moderate heat, and when partly covered by brick arches, exposing only the lower edge, it will stand for some time. But in such fires as break out in the great manufactories and warehouses of London, New York, Chicago, and Philadelphia, where large quantities of inflammable goods are piled beneath ceilings, supported on rolled iron beams, they yield, and, in falling, ruin all floors below. If protected by thick plaster upon wire cloth or netting, or by tiles so moulded as to cover the lower side of the lower flange, they will stand longer; but even then I doubt their safety in great fires. Cast and wrought iron in the form of story-posts or pillars also quickly yields to the heat of these great and fierce conflagrations. No stone, unless of horizontal section, covering more floor space than can be ordinarily spared, will safely resist these fires, and when iron or stone yields it yields suddenly and disastrously. A more unsafe staircase than one of slate upon wrought-iron beams can hardly be made. Slate explodes under a moderate heat like granite, but with greater violence. I have seen the occupants of a new log hut in Lookout Valley driven out of it by the flying slate of the walls of its chimney and open fire-place.

"Brick is the only real fire-proof material available at reasonable commercial cost, and it should be used in masses of considerable thickness to be safe. Light square pillars will not stand. Piers of some thickness and of considerable horizontal length will long resist fire. The safest story-post—*i. e.*, a post supporting a floor at reasonable cost—is one of some hard and not resinous timber. Posts of oak, of fourteen inches square, will stand safely through almost any fire, until the powerful force and means of our city departments are able to quench the fire. If wrapped with wire netting, covered afterward with plaster, they will suffer still less; but the naked wooden post will remain cool and strong in its centre for hours, and the fire will not for a long time char it to a depth sufficient to much injure its strength."

With regard to fire-proof floorings, we cannot do better than quote from the same letter, wherein a number of excellent suggestions are given on this subject: "A not very costly and a very fire-resisting floor is described in the old books on carpentry. It is in a room sixty feet square in Amsterdam. It is built of three thicknesses of one and-a-half-inch plank, tongued and grooved, well nailed and laid crossing each other at different angles. The edges of the floor rest on offsets all around the walls. It is reported as very stiff and strong. Air would circulate but slowly through such a floor, and if between the two lower layers of plank a course of felt or of strong paper were laid, all such circulation would be cut off. Even this floor would be safer—*i. e.*, it would resist fire longer—if it was plastered on wire netting on the under side. A good floor can be made on the plan so well advocated by Mr. Edward Atkinson, with one or two layers of thick plank tongued and grooved or splined, resting on stout beams eight to twelve inches wide and of depth to give the necessary strength. For this floor he recommends a course of plastering on wire netting, inclosing the beams and following

the lower surface of the plank so as to leave no empty concealed spaces in which fire can find a hidden lodgment and way to spread. The modern Roman floors are very generally laid on stout, rough beams, flattened on top, placed at such intervals that the broad, thin bricks or tiles used in Italy can be laid so as to span the openings between the beams; a second layer of bricks or tiles laid in mortar (all Roman mortar is a cement of sand, lime and puzzolana, a volcanic cement) completes the strength of the floor. It is in the better houses finished with marble tiles or with a fine concrete of cement, lime, sand, and broken bits of marble, of red, hard-burned bricks, or of pottery, which, after setting hard, is rubbed down with sand and polished, making either a closed imitation of breccia marble, or, if red brick or pottery broken from the body of the stucco, then it is what the Romans in Pompeii called *opus signinum*. The ceiling below is plastered and the floors are almost incombustible.

All stone stairs and posts are dangerous in great fires. Limestone calcines, sandstone cracks, granite and slate explode into fragments. Captain Shaw, of the London fire brigade, in an excellent treatise published in 1872, stated that his men were not permitted to enter, in case of fire, warehouses in which there were iron or stone story-posts or floor-beams, or even to attempt to use stone stairs. He had seen stone stairs lying in a heap at the bottom of the stair-well after a very moderate fire. In Rome the stairs are universally of brick. The landings are brick arches of very slight rise turned across the ends of the stair-well or staircase, the flights of stair rest on inclined, rampant brick arches springing from the edge of one landing to the next above at the other end of the well. The upper surfaces of these arches are brought to the form of a flight of steps. For beauty, the treads, and sometimes the risers also, are made of thin slabs of stone, generally either travertine stone or marble, which is abundant and cheap in Italy. These are very handsome, stately stairs, not very costly, and as nearly fire-proof as can possibly be built.

There is another thing in connection with floors, and that is, that they should be so constructed as to be in a measure water-tight, and on the same principle as the deck of a ship, so that in the event of a fire in the upper stories the damage which now necessarily ensues, by reason of the deluge of water applied, may be obviated; in other words, let the floors of buildings be caulked, so that they should be perfectly water-tight, and whether water should be spilt by accident or by design, as in the case of fire, no damage to the goods stowed beneath would occur. The first thought which occurs to one is, that in the event of a hose being turned on to an upper story, the water, finding no outlet, would flood the room to any depth, but the providing a gutter round each room communicating with pipes piercing the walls and carrying away the water as a rain-water pipe now does, would remove this danger. No doubt were this plan carried into effect, the first cost of erection would not be somewhat increased, but to the person intending to use any particular house for the storage of valuable and perishable property, it is well worthy of consideration whether it would in the end "pay" to adopt the

plan in preference to having a whole house full of property damaged or spoiled by the supply of water to a fire occurring in an upper room.—*The Builder and Wood-Worker.*

VARIETIES OF THE ELECTRIC LIGHT.

Many persons are waiting before adopting the electric light until there shall be a demonstration which lamp is the best. The various accounts of the lights in the Paris Exhibition indicate that the competition is not establishing decided superiority of either the arc or the incandescent method, but rather is showing that each has peculiar advantages for particular situations. Very probably the arc light, which is the more powerful, yet more simply produced, may come to be preferred for engineering operations, for light-houses and vessels, and for streets and parks, while the incandescent method which gives a milder, steadier effulgence, may win favor for use in halls, shops and dwellings. In the main hall of the exhibition lamps of all kinds have been in use and, to promote comparison, twenty-nine apartments in the gallery have been lighted, each by a single system. The nature of the arc method has been made familiar in this country by the Brush lamp, the Fuller, the Wallace and the Weston, and by the arc lamp of Maxim. Its light is emitted by the electric current as this flows from one to the other of two carbon points; but unless these two points can be made to approach each other precisely as fast as they are consumed by the heat, a disagreeable flicker is the result. In the incandescent method, which is that of the Edison lamp, the Sawyer, and the incandescent lamp of Maxim, the light is emitted by a carbonized fibre, raised to white heat by passage of the current through it, but to protect the fibre from being consumed, it must be hermetically sealed in a glass globe. The arc method allows the carbon to be slowly consumed; the purpose of the mechanism is to replace it steadily; the incandescent seeks to prevent the consumption. The long effort to devise means of avoiding the flicker without incurring the mechanical difficulties incident to the exhausted globe, has developed many forms of lamp, and several as yet little known in this country are in the exhibition.

In the Compton lamp a vertical metallic rod is held pinched more or less strongly, according to the force of the current, between two pieces of metal, the friction on the rod being varied according to the strength of the current, and the friction regulates the approach of the points. In the Pilsen a piece of iron of spindle form is made the common core of two electro-magnets, one placed above the other, and is drawn up or down, according to the variation in the current. In the Serrin, clock-work, regulated by the current, moves the points toward each other. In the Werdermann the purest carbon which can be obtained is used. In order to avoid accumulation of ash, a rod of it is passed from beneath against a block of carbon, and as fast as the point is consumed the rod ascends. The Reynier, in its most recent models, is like this, except that the block is un-

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derneath and the rod rests upon it from above. These two lamps are intermediate between the arc and incandescent kinds. In the Joel a carbon point from below bears against a copper disc above. The Soleil is like the Joel, except that the point of contact between the carbon point and the copper disc is surrounded by chalk or lime which is rendered incandescent. In the Jamin, which is a simplified form of the well-known Jablochkoff candle, the strip of glass or plaster, which, in the latter, separates the two carbons standing side by side, is discarded, and the carbons stand with only air between them. The Swan light, which is of the incandescent class, has been used for the meetings of the Congress in the Salle des Seances and in the auditorium of the Opera-House, on a gala performance, given in honor of the Congress.—*Iron Age.*

ARTS AND SCIENCE OF ANCIENT ROME.

HORATIUS FLACCUS, 30 B. C.

Mæcenas, noble son of royal line
Protector mine, effulgent patron, friend:
(In aims and tastes diversely we incline
As ever 'twas and will be to the end.)
Some love the Olympic dust to raise,
The goal with glowing chariot-wheels to graze,
And so the victor's palm, illustrious, prize
That haughty gods from terrene men they rise.
This one exults when changeful Romans praise
And three-fold honors 'round him strive to raise;
Another, when the grain from Libyan floors
Is swept and locked within his granary doors:
A third th' ancestral fields prefers to till—
Attalic wealth could ne'er on him prevail
To cleave the Myrtoan wave with Cyprian keel.
The merchant, prospering, dreads Ægea's wind-tossed seas
And, boastful, lauds his city's tranquil ease;
But soon, unwilling yet stern want to face,
His disused ships refits for ventures fresh.
This one nor cups of ancient Massic wines,
Nor wasteful hours from busy day, declines,
Now stretched supine beneath th' arbutus' shade,
Now, near the sacred murmuring fountain head.
The camp, with fife and trumpets' mingled sound
Delights; e'en war, so feared by mothers' fond.
The hunter, heedless of his spouse's tender care,
Delays, unmindful of the freezing air,

If faithful hound an agile doe espies
Or Marsyan boar the entangling net defies.
But me, green ivy wreaths, the fit rewards
For learned brows, exalt with proudest gods.
Cool groves where dance the nymphs and satyrs gay
While soft Euterpe's flutes unhindered play,
And, unrestrained, Polhymnia's Lesbian lyre;
These raise me 'bove the common mass still higher;
But if you class me with the lyric bards
My lofty crown shall touch the heavenly stars.

NOTES AND QUERIES.

In the REVIEW for August, 1881, the following query was propounded: "I have a copper-gilt medal, two inches in diameter, dated 1712 with a lion and bear rampant over two shields, sword in hand, blazing sun above them and the inscription 'Hoc duce pugnamus,' all on the obverse side. On the reverse is the date as above, a quantity of flags, arms, drums, etc., with the inscription, 'Un— crescunt splendore leones et ursi.' Can any one explain it and inform me what occasion it was intended to commemorate?" C.

This medal was shown to many persons, here and elsewhere, and was finally left with a young lady on Long Island for investigation, with the following result:

PHILADELPHIA, February 21, 1882.

* * * "The medal is supposed to be one struck in commemoration of the union of the Catholic and Protestant Cantons of Switzerland in the year 1712. The lion is the Lion of Lucerne, the leading Catholic Canton. The bear is the Bear of Berne, which took the lead of the Protestant Cantons. The seven flags on one side of the medal are the banners of the seven Catholic Cantons which were victorious. The inscription on one side is as we had it, *Hoc duce pugnamus*—'Under this leader we fight.' I wish I could find the name of the leader under whom this union was effected. If his arms or symbol should prove to be a sun, I think it would add greatly to the credibility of my theory.

"Now for the other side of the medal. The word that is partly effaced we suppose to be *uniti*, so that the inscription reads *Uniti crescunt splendore Leones et Ursi*, 'United the Lions and Bears increase in splendor.'" * *

MARIE JEFFERYS.

If any of our readers can improve upon this explanation we shall be glad to hear from them.—ED. REVIEW.

EDITORIAL NOTES.

THIS number of the REVIEW concludes the fifth year of its existence, and it only remains for us in closing, to renew our thanks to our subscribers for the patronage which has enabled us to keep it afloat so long. It has been a hard and rather costly struggle and would have resulted in failure long since had it not been for the accustomed loyalty of the people of Kansas City to all laudable enterprises started among them. It is safe to say that in no other city of the whole West could such a magazine have survived more than one year.

We feel that in return for this support we have rendered a full equivalent in the character and quality of the reading matter we have furnished. Of this we are assured, not only by the comments of home readers, but also by the compliments received from readers at a distance on both sides of the Atlantic, as well as on the Pacific coast.

It must not be inferred from these remarks that the REVIEW is even now in a prosperous condition. On the contrary, it barely pays expenses, and needs at least one hundred more subscribers to make it really and clearly self-supporting. Its circulation is, however, constantly widening and its sphere of usefulness extending, so that with the natural and proper increase of patronage at home, we shall at least be enabled to improve it from time to time and thus deserve more aid from our friends. We have no other object than this in view, as it must be manifest to all that a periodical of its class can scarcely be expected to become a source of much profit to its publisher.

THE Kansas City Academy of Science has at last secured a home of its own, having taken the handsome room lately vacated by the Medical College in the third story of the "Diamond" building. Its library and collections of specimens have been placed there, and friends who have contributions to make to either object can feel assured that hereafter what they give will be properly arranged and carefully preserved.

There are valuable geological, mineralogical and archæological specimens enough lying about, uncared for, in this city, to make up a handsome museum, and we call upon those having them to turn them over to Mr. Hare, the Curator, who will gladly receive, label them with the names of the donors and lock them up.

In this way we can very soon gather together a collection which will be not only creditable to the Academy, but of real service to scientists and to the youth of our city.

THERE seems to be scarcely a vestige of hope left that any of the officers and crews of the two missing boats of the Jeannette will ever be found alive. In our next issue we shall give an extended and reliable account of this disastrous voyage.

THE extreme loss of life and property and the great expense to the Government, occasioned by the floods along the Mississippi River, from Cairo to the mouth, will precipitate some decisive action on the part of Congress, to guard against such disastrous results in the future. In view of the experience with the levees during the past few weeks the "outlet system" looms up quite prominently as very possibly the really practicable remedy after all.

THE following inscription was once upon the house at Harlem, formerly occupied by Laurent Koster or Coster, who is charged, among others, with the invention of printing. Mention is first made of this inscription about 1628:

HEMORTÆ SACRUM,
TYPOGRAPHIA
ARS ARTIUM OMNIUM
CONSERVATRIX.
HIC PRIMUM INVENTA
CIRCA ANNUM MCCCCXL.

THE Kansas City Book and News Company has just issued a new pocket map of this city which is correct in arrangement, tasteful in appearance and convenient in shape. Price 50c.

MR. F. B. BROCK, the well known patent lawyer of Washington, begins in this issue of the REVIEW a series of articles or reports on "Improvements in the Mechanic Arts," in which he will describe and discuss the more notable inventions patented during each month.

ALL subscribers wishing their back numbers of the REVIEW bound can have it handsomely done in half morocco and cloth sides for $1.00 per volume, by leaving them at this office. Those sending by mail should remit twenty-eight cents for return postage on each volume.

OBSERVING that several of the scientific periodicals of the East are just now publishing statements by various chemists that the so-called "Ozone," much vaunted as an antiseptic by its patentees and vendors, is merely a mixture of sulphur and charcoal, scented with cinnamon, we take occasion to say that Professor G. E. Patrick, of the Kansas State University, exposed this nostrum in the Lawrence *Journal* at least three months ago.

WITHIN the past year the following manufacturing enterprises have been established in Kansas City and its suburbs: The Kansas City Smelting and Refining Works, said to be one of the largest in the world; the Rochester Glucose Works, occupying a building seven stories high; the Kansas City Iron Pipe Works, one of the most extensive in the country; the immense boot and shoe factory of Victor B. Buck & Co.; the White Lead Works, besides a great number of smaller enterprises.

TO the reader interested at all in any of the scientific subjects of the day, his reading could hardly be complete without the REVIEW.—*Lawrence* (Kas.) *Journal.*

THE Kansas City REVIEW OF SCIENCE AND INDUSTRY is not only well printed, but conducted with marked ability and enterprise, and deserves a wide patronage.—*Missouri Statesman.*

MAJ. F. F. HILDER, author of the prize essay, "The Three Americas," and a member of the St. Louis Archæological Society, has prepared a lecture upon the subject, "Prehistoric Missouri; or, Mounds and Mound-Building."

THE Kansas City REVIEW OF SCIENCE AND INDUSTRY, is an ably managed publication. The aim of the publisher is to lay before the reader the substance of the latest scientific and literary articles, written for the best publications in special fields of literature, and also to publish papers on subjects relating to the West, prepared for the REVIEW by eminent writers.—*Bulletin.*

MR. WILLIAM W. GOODMAN, Eliot Professor of Greek Literature in Harvard University has accepted the invitation of the committee of the Archæological Institute of America to assume the directorship of the school at Athens for the first year.

A dispatch from Copenhagen, says: "A Danish polar expedition, to start in July, has been arranged. The Chamber, to-day, voted an appropriation toward paying the expenses of the expedition.

THE Kansas City REVIEW OF SCIENCE AND INDUSTRY has numerous articles relating to natural features and scientific enterprises. Such periodicals are an advantage and credit to the country.—*N. Y. Observer.*

SNOW has fallen in Athens, and the winter as a whole, has been the severest known in a generation. In the village of Cephissia, at the foot of Pentelikon, only a few miles from Athens, the snow was for days in February six feet deep. In Athens the streets were blocked for days with three feet of snow. The day before its fall the streets had been sprinkled with water, owing to the clouds of dust.

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THE death, at the Observatory, Armagh, of the Rev. Thomas Romney Robinson, D. D., Royal Astronomer of Ireland, is announced. He was eighty-nine years of age, and had occupied the office of Astronomer Royal for nearly sixty-seven years.

THE Report of the Fifteenth Annual Meeting of the Missouri Press Association has been printed in most tasteful style by J. West Goodwin of *The Bazoo*, Sedalia, Mo. It is a model of typography, press-work and paper.

HAVENS' Mill at Leavenworth, Kansas, was destroyed on the 23d ult., by an explosion in the dust room, followed by a fire which consumed the entire property.

ITEMS FROM PERIODICALS.

A correspondent of the St. Louis *Globe-Democrat* says that the mounds of the prehistoric people in the overflowed districts, and the uses to which they have been applied as life-saving stations, suggest the means by which the great Mississippi Valley may be peopled and cultivated with safety and profit. These overflows are liable to occur at frequent periods, and are of value to the soil; they renew the wornout lands and preserve them forever new. The disadvantages are such as are now apparent in the sweeping away of buildings, drowning of stock, and the loss of human lives. These can all be preserved by building residences, store-houses and stock corrals on artificial mounds, which can be made at less cost than is involved in abortive attempts to hedge in the mighty floods within the imaginary bounds of a river.

M. DESIRÉ CHARNAY resumes in the *North American Review*, for April, his account of explorations in Central America. He claims that his recent discovery of *bas reliefs* depicting equestrians and other objects pertaining to the Spanish conquest, show that they were not executed earlier than A. D. 1410, and says that "it is time that an end should be made of the absurd claims of high antiquity made for these remarkable monuments of indigenous American civilization."

JOHN FISKE contributes an article to the *Atlantic Monthly*, for April, of great popular and scientific interest entitled "Europe before the Arrival of Man," and promises another at an early day upon "The Arrival of Man in Europe." We copy a portion of the former in this number.

THE Louisville *Courier-Journal* claims for Captain Ward, of Sumter, S. C., the ownership of the oldest book in America, "The Life of William Cavendish, Duke of New Cast'e," published in 1685. The absurdity of this claim is shown by the editor of the New York *Observer*, who states that "volumes printed between 1450 and 1500 are to be found in numbers of our private as well as public libraries." The editor of the REVIEW owns a volume entitled "The Haven of Health," by Dr. Thos. Cogan, printed in 1588, and there are several books owned in this city that were printed 300 years ago or or over.

THE new offices of the New York *Observer* are in Barnes' Building, No. 21 Park Row. It is published every Thursday from its new office, in its unusually handsome style. This veteran of the religious press, having passed uninjured through the fire will continue its former good work with fresh vigor and accustomed courage while its secular department will be second to no newspaper of this country in matters relating to literature, art, science, etc.; $3.15 per annum.

THE *Popular Science Monthly*, for April, says that M. A. Laveran has found in the blood of patients suffering from malarial poison, parasitic organisms which are not found in the blood of persons suffering from diseases that are not of malarial origin. These organisms rapidly disappeared under the influence of the quinine treatment, and the addition of a minute quantity of a dilute solution of sulphate of quinine to a drop of blood sufficed to destroy the organisms.

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